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ABSTRACT

A study was conducted to test the thesis that teaching word recognition skills in a manner compatible with the learner's auditory or visual modality preference would facilitate beginning reading instruction. A group of 62 students in two first grade classrooms was studied; one class stressed the presentation of words as whole units, the other stressed phonics. At the end of the academic year, correlation coefficients were computed between the difference scores that indicated modality preferences and scores in reading achievement. Results indicated the following: (1) no significant relationships were demonstrated between either the components or total modality preference scores and word recognition scores, regardless of teaching method; (2) those students in the phonics classroom with visual modality preference scored significantly higher on the word recognition test than did those with auditory preference; and (3) there was no significant difference in word recognition skills between classes when instruction stressed the whole word approach. (Author/DF)

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Final Report

Project No. 1-B-088
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MODALITY PREFERENCE INSTRUCTIONAL METHOD, & READING ACHIEVEMENT WITH FIRST GRADERS

April, 1974

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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ABSTRACT

It had been proposed that teaching word-recognition skills in a manner which was compatible with the learner's modality preference would facilitate learning to read. Specifically, those with auditory preference would be more successful than those with visual preference when instruction stressed phonics. The corollary position was stated that those with visual preference would be more successful than those with auditory preference when instruction stressed presenting words as whole units. The purpose of this study was to explore these two positions.

Modality preference was defined by differences in performance on the auditory and visual measures of discrimination, memory, and closure which were administered at the beginning of first grade. In each variable, the subject's auditory-standard score was subtracted from his visual-standard score in the same variable. Thus, there were three difference scores which indicated modality preference obtained for each subject. Total modality preference was computed by summing these three difference scores. For all scores, a positive difference score was interpreted as indicating visual preference and a negative score as indicating auditory preference.

Two classrooms of first-grade students served as subjects. When entering first grade, both samples were of average

chronological age but with above average intelligence and represented middle socio-economic populations.

Instruction within one classroom (School 1) stressed presenting words as whole units (Bank Street Readers, Macmillan). Instruction within the other classroom (School 2) stressed phonics (Palo Alto Reading Program, Harcourt, Brace, Jovanovich).

At the end of first grade, correlation coefficients were computed between the difference scores which indicated modality preference and reading-achievement scores. Separate analyses were undertaken for each classroom.

No significant relationships were demonstrated between either the components or total modality-preference scores and word-recognition scores regardless of the method employed in teaching. Second, those with visual-modality preference scored significantly higher on the word-recognition test than did those with auditory preference ($\underline{t}=2.12$, $p < .05$) in the classroom which stressed phonics. Third, there were no significant difference in word-recognition skills between those with visual preference and those with auditory preference when instruction stressed the whole-word approach.

A significant correlation coefficient ($\underline{r}=.429$, $p < .02$) was computed between total modality preference and comprehension scores in the classroom which stressed phonics. None of the other correlation coefficients computed between any of the components of modality preference and comprehension scores reached significance. No significant relationships were demonstrated between either any of the components or total modality-preference scores and comprehension scores in the classroom which stressed the whole-word approach. Again, those with visual preference scored significantly higher on the comprehension test ($\underline{t}=3.25$; $p \leq .01$) than did those with auditory preference when instruction stressed phonics. Finally, there were no significant differences in comprehension scores between those with auditory preference and those with visual preference when instruction stressed the whole-word approach. Thus, the interpretation of the data did not support the position that teaching word-recognition skills in a manner which was compatible with the modality preference of the learner would result in differences in reading-achievement scores for the samples employed.

Further analyses of the data resulted in little support for the underlying premises that auditory abilities were related more to success than were visual abilities when instruction stressed phonics or that visual abilities were related more to reading success than were auditory abilities when instruction stressed the whole-word approach.

Finally, there was no significant difference in the modality preference of the subjects with the 10 highest reading-readiness scores and those with the 10 lowest reading-readiness scores in either classroom. Thus, differences in modality-preference did not appear to differentiate between those with high and those with low reading-readiness scores.

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CHAPTER I

STATEMENT AND DEFINITION OF THE PROBLEM

Most children enter school with the ability to learn, yet some fail to learn or to make satisfactory progress during the initial stages of reading instruction. The possible reasons for this situation have been the subject of much conjecture. Some writers cite the shortcomings of particular approaches in teaching beginning reading. Research, however, has shown that no one approach is the most effective for all children. Other writers are of the opinion that there is a combination of factors within children which may contribute to their difficulty in learning to read. But, there is little evidence regarding the exact relationship between these factors and success in learning to read.

Few would disagree that children differ in characteristics. Likewise, it seems very likely that reading approaches differ in the demands made upon the learner. Yet few attempts have been made to investigate the possible interactions between certain characteristics within children and the demands made on the students by the particular approach to reading being employed. One such characteristic of children has been termed auditory- or visual-modality preference. If it could be demonstrated that there is an interaction between the modality preference of individuals as indicated by test results and the demands made on the learner by the beginning-reading approach used, failure in the beginning stages of reading instruction might be lessened by adjusting instruction to this characteristic of the learner.

Purpose of the Study

The purpose of this study was to explore the relationships among modality preference, method of beginning reading instruction, and reading-achievement scores.

Specifically, this study attempted to answer the following questions which were related to understanding the interaction between modality preference and reading-achievement scores:

1. Does consideration of modality preference make a significant difference for success in beginning reading?
    a. What is the relationship between modality preference and reading-achievement scores?
    b. Are children with auditory-modality preference more likely to succeed in a program which emphasizes phonics than are children with visual-modality preference?

c. Are children with visual-modality preference more likely to succeed in a program which emphasizes the whole-word approach than are children with auditory-modality preference?

d. Do differences in performance on the auditory and visual tests differentiate between good and poor readers?

e. Are there significant differences in the reading-achievement scores among those with various amounts or degrees of modality preference?

In addition, this study also considered the following related questions:

2. Do the whole-word and phonic-linguistic beginning-reading approaches demand differing perceptual abilities on the part of the learner?
3. Do the distributions of modality-preference difference scores deviate significantly from normal distributions?
4. Do the children with the lowest reading-readiness scores differ in modality preference from those with the highest reading-readiness scores?

Procedures

To aid in drawing conclusions concerning the questions posed in this study, data were gathered through a procedure which involved the following steps:

1. Selecting an appropriate sample.
2. Randomly assigning treatment to classroom.
3. Holding teacher workshops to acquaint teachers with the procedures.

4. Developing reading readiness by classroom teachers.
5. Administering the screening tests of auditory and visual acuity.
6. Administering a standardized reading-readiness test.
7. Administering tests of discrimination, memory, closure, and intelligence.
8. Gathering personal data about each subject: age and sex.
9. Teaching of beginning reading by classroom teachers.
10. Gathering demographic data from census tract information: income, schooling, and type of housing found in the community of each school.
11. Observing throughout the school year to assure that the teachers were employing the assigned treatment.
12. Administering a standardized reading-achievement test.
13. Readministering the tests of discrimination, memory, and closure.
14. Collecting and processing the data.
15. Drawing conclusions and reporting findings.

Theoretical Framework

The theoretical construct employed in this study for viewing the learner's characteristics was based on the modality-preference concept as advocated by Wepman (1968). The basis for this construct was suggested by Charcot and reported by

Freud in his monograph, On Aphasia, which was published in an English translation in 1953. Charcot used the terms "audile" and "visile" learners. That is, those who learned better through listening as opposed to those who learned better when able to see the material to be learned.

In his statement of the modality-preference concept, Wepman (1968) assumed that some individuals had developed perceptual pathways better in one modality than in the others for processing information received from the senses. He explained that in some individuals the preferred modality matured earlier because of some innate neurological tendency. The preferred system typically appeared to come to complete use and function at an early age. In the audile child the auditory pathways developed with greater ease and matured earlier than the visual pathways. Because perceptual basis was necessary before cognitive learning could take place, in an audile child, ". . . both perceptual and conceptual function would develop early with consequent early and accurate acquisition of speech [p. 3]." Although he failed to explain language acquisition in the visile child, Wepman did state that high intelligence may provide automatic compensation for slow auditory-perceptual development.

As support for this modality-preference concept Wepman, (1968) offered two kinds of evidence, phenomenological and clinical. As an example of the former he described Toscanini as having heard every note of the music he read and Picasso as having seen ". . . in his unique way even the sounds of the animals [p. 2]."

Citing his work with adult aphasics, Wepman offered experimental evidence based on that clinical work. He stated:

> . . . a factor analytic study of responses of 165 adult aphasic patients on auditory and visual items of the Language Modalities Test for Aphasics showed, ". . . for all analyses (a single factor) was best defined by all items demanding oral responses to visual stimuli . . . the oral responses to auditory stimuli appeared as a separate factor" [1968, p. 3].

Theoretically, the concept of modality preference was not without opposition. Thorndike (1911), who had not identified learning types or modality types, stated:

> Having a large measure of one good quality increases the probability that one will have more than the average of any other good quality. He who can learn better than the average through the eye, tends to learn better than the average through the ear [pp. 26-7].

Sixty years later, the evidence pertaining to modality preference or type was inconclusive. Higgens and Gage (1968) and Jester and Travers (1966) have shown in their research that some individuals tended to prefer one modality more than the other for learning. Jensen (1971), however, did not find such differences.

However, if Wepmen (1968) was correct in suggesting that the preferred pathway came to full use earlier and that perceptual experiences became the basis for later conceptual learning, there appeared to be a need to look at the demands made upon the sensory pathways by the differing methodologies used in teaching beginning-reading skills.

Rationale

Durkin (1970) offered a basis for examining the processes involved in learning to read. She suggested that research needed to be conducted that would help to match children, in terms of their abilities, with the method of teaching, in terms of what it required of the learner.

Combining the type of research suggested by Durkin with the modality-preference concept implied that research should be undertaken which would delineate the phases of reading acquisition, look at the types of learning necessary at each stage, clarify what appeared to be the demands of the differing methodologies, and match them in terms of the abilities of the learner.

This study was to serve as exploratory research to clarify the interaction among the underlying abilities in auditory and visual modes, modality preference, and reading-achievement scores during the initial stages of reading acquisition. This study also explored the relationships among the components used to define modality preference and reading-achievement scores under two different methods of reading instruction.

One of the first phases of reading acquisition involves the development of word-recognition skills. Basically, these skills can be developed initially in one of two ways: (1) teaching children to recognize words as wholes (whole-word approach); or, (2) teaching symbol-sound associations which allow children to decode words (phonics approach). These approaches to teaching beginning reading were based on differing theoretical positions.

One theoretical position held that meaning should be stressed throughout instruction, even at the early phase. This approach has been implemented in programs which initially present the word as a unit of meaning (Chall, 1967). Through repetition, configuration clues, and use of context, the student is taught to recognize words as wholes; thus, it is often referred to as the "whole-word" approach.

A differing theoretical position stressed that children learning to read first must acquire the symbol-sound associations which would help them "sound out" new words. In this phonics approach, decoding is taught early and a concentrated emphasis placed on learning to associate the sounds with the letters which represent them (Chall, 1967).

Although reading involves both auditory and visual abilities, it was theorized that their significance for reading achievement in a particular method may vary with the different demands of that method due to the stimuli and the methodology employed. For example, whereas the whole-word approach appeared to require the ability to discriminate visually and auditorily between and among total word forms and sounds, the phonics approach, at least initially, appeared to require visual and auditory discrimination between and among letter forms and sounds. It also appeared likely that the two approaches make different demands on the learner in terms of auditory and visual memory and closure (Bannatyne, 1971; chalfant and Scheffelin, 1969).

The use of the concept of differing modality preferences seemed to imply that instructional techniques should be based on the abilities of the individual child in terms of the auditory and visual demands of the learning task. As Wepman stated:

> Stress needs to be placed in initial stages of learning on the perceptual level, or the later learning may be faulty and without a basic structure upon which the child can develop his linguistic skills [1968, p. 3].

However as Cullinan (1969) pointed out:

> Use of modality to develop reading ability to process information is seldom disputed , but there is little unanimity on the degree of the relationship or the level of dependence of reading ability upon a particular sensory development [p. 3].

There has been little research evidence that indicates teaching methodology based on modality preference might make a difference and help prevent failure in the beginning stages of reading. However based upon the implications of research conducted during the 1930's (Bond, 1935; Gates, 1939b) the possibility of such interaction between the learner's characteristics and the demands of the methodology appeared to exist and therefore needed to be explored further.

Definition of Terms

In this study, these terms were defined in the following way:

Acuity

Acuity referred to keenness of vision or hearing. Visual acuity was assessed with a screening test using the Keystone Telebinocular (Keystone Vision Company). Auditory acuity was measured by a *Sweep Check Test* with a Maico audiometer.

Closure

Closure referred to the tendency of an individual to modify the unorganized patterns of stimulation toward a configuration with more "goodness" (Koffka in Forgus, 1966, p. 114). Specifically, auditory closure was assessed by performance on the auditory-closure subtest of the *Illinois Test of Psycholinguistic Ability* (Kirk, McCarthy, & Kirk, 1968). Visual closure was assessed by performance on the *Higgins-Wertman Test: Threshhold of Visual Closure* (Higgins & Wertman, 1968).

Difference Scores

Difference scores referred to the data points used to determine modality preference. These scores were computed by calculating the difference between the visual-subtest standard score and auditory-subtest standard score in each component measured: discrimination, memory, and closure. The difference scores were computed:

$$\text{Difference score} = z_v - z_a = \frac{X-\bar{X}}{s}$$

A complete listing of the difference scores for each subject is found in Appendix A.

Discrimination

Discrimination referred to the ability to determine auditory or visual likenesses or differences between stimuli.

Auditory discrimination was assessed by performance on the Auditory Discrimination Test (Wepman, 1958).

Visual discrimination was assessed by performance on the Lee-Clark Readiness Test (Lee & Clark, 1960) and an informal measure used in the Katz and Deutsch study (1963 a).

Memory

Memory referred to the ability to recall or to remember those things seen or heard. In reading, this included the symbol-sound system of the language, as well as a sequence of events or ideas, and the meaning of the vocabulary. Only short-term memory was assessed in this study.

Visual memory was assessed by performance on the word-form memory subtest of the Gates Reading Readiness Test (Gates, 1939 a) and a Memory for Pictures Test. The items and the directions for administration of the Memory for Pictures Test appear in Appendix B.

Auditory memory was assessed by performance on the Memory for Nouns subtest (Katz & Deutsch, 1963) and the Auditory Attention Span for Related Syllables of the Detroit

Test of Learning Abilities (Baker & Leland, 1959). The items and directions for administration of the Memory for Nouns subtest appear in Appendix C.

Modality Preference

Modality preference referred to an interpretation of an individual's performance on the tests that indicated that his visual or auditory abilities were better in one mode than in the other. This interpretation was made from the difference scores. A score higher than zero indicated a visual preference; a score lower than zero indicated auditory preference; and, a score of zero indicated no preference. This was true for both component modality-preference and total modality-preference scores.

Arbitrarily modality preference was separated into four categories indicating degree or amount of preference:

a. Maximum--Maximum modality preference referred to a strong indication that an individual appeared to prefer one modality more than the other for perception and/or learning. Specifically in this study, difference scores in all components measured had to be at least .5 in the same direction in all three areas: discrimination, memory, and closure.

b. Middle--Middle modality preference referred to a moderate indication that an individual appeared to prefer one modality more than the other for perception and/or learning. The difference scores had to be at least .5 in the same direction in two of the three areas: discrimination, memory, and closure.

c. Minimum--Minimum modality preference referred to a slight indication that an individual appeared to prefer one modality more than the other for perception and/or learning. The difference scores had to be at least .5 in only one of the three abilities measured in this study.

d. No--No modality preference referred to an indication that an individual did not prefer one modality more than the other for perception and/or learning. This would include two subgroups: 1) those whose difference scores were less than .5 in all of the components measured; and, 2) those whose difference scores were .5 in a positive direction in one component, .5 in a negative direction in the second component, and less than .5 in the third component.

A summary of the number of subjects within each of the above classifications is found in Appendix D.

Perception

Perception referred to sensations received by the brain which may affect the organisms behavior. Although some psychologists distinguish between sensation and perception, no such dichotomy was used in this study. Specifically in this study, perceptual abilities were operationally defined as the component abilities used as measures of modality preference: discrimination, memory, and closure.

Reading Achievement

Reading achievement referred to the ability to understand printed materials. In this study, it referred to scores attained on a standardized reading-achievement test, Gates-MacGinitie Reading Test (Gates & MacGinitie, 1965).

Successful reading achievement referred to a grade-level score of 1.7 or above at the time of final testing. This was equivalent to a normalized score of 44 or above on the norms given with the test directions (Gates & MacGinitie, 1965).

Nonsuccessful reading achievement referred to a grade-level score of 1.6 or below at the time of final testing.

Word Recognition Ability

Word recognition ability referred to the ability to identify correctly a word stimulus. Specifically, it referred to the ability to choose the correct word from among four words of similar configuration which identified an illustration on the vocabulary subtest of the Gates MacGinitie Reading Test, Primary Form A (Gates & MacGinitie, 1965).

Assumptions

This study was based on the following assumptions:

1. Discrimination, memory, and closure are components of perceptual abilities and modality preference and therefore, could be used as measures of them.

2. The instruments used to measure the perceptual abilities and reading achievement are valid and reliable.
3. The reading materials used in the treatments represented either the phonic or whole-word approach.

Limitations

The generalizations made from the results of this study were restricted by the following factors:

1. Only two first-grade classes were employed.
2. The population from which the sample was drawn represented middle-income populations.
3. The effectiveness of the teacher probably influenced the reading achievement of the students.
4. Use of different instrumentation and/or reading-instructional materials may have led to different findings.
5. Defining modality preference in a different way may have led to different results.

Summary

This chapter has focused on presentation of the problem, the theoretical framework, and the rationale of this study.

Many children enter school with the capacity to learn to read, yet fail even at an early phase, word recognition. The theoretical position offered the suggestion that children be matched in terms of their visual and auditory abilities, modality preference, in terms of what appeared to be the demands of the two main methodologies for teaching word recognition, phonics and whole word. The theory proposed that those with auditory-modality preference were more likely to succeed in a phonics approach while, those with visual-modality preference were more likely to succeed in a whole-word approach. Yet, there has been little research evidence to support the construct of modality preference or the efficacy of this practice.

The purpose of this study has been stated as having as one of its objectives to explore the possible relationships among differing methodologies, the visual and auditory skills of the learner, and modality preference.

If an interaction between the learner's modality preference and success in learning to read using differing methodologies could be demonstrated to exist, then adaptation of instructional techniques at the early phases of reading instruction to the modality preference of the learner may lessen failure for some children.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Historically, educational researchers have been intrigued by questions which sought to find and to relate important variables of learning with characteristics of the individual learner. When the Cooperative First-grade Studies (Bond and Dykstra, 1967) indicated that no one method of reading instruction was the most effective for all learners, reading researchers once again emphasized possible interaction between the learner's characteristics and the methodology employed in beginning-reading instruction.

Major trends of these two avenues of research which are related to this study included: relationships between mode of presentation and learning; individual learning types; perceptual differences between good and poor readers; perceptual differences among first graders; adaptation of reading instruction to individual needs; and, the main concern of this study, the efficacy of modifying beginning-reading instruction to the modality preference of the learner.

The above areas were included in this review because they appeared to show the historical development of the concept of modality preference or they related some of the learner's characteristics to reading success. Within each of the above areas, the review was limited to studies which reported major findings and trends or were indicative of the historical progress of the lines of research.

Generalizations from the findings in each area were difficult to draw because researchers defined learning and abilities in different ways and used differing measures and tasks to assess the same skill or ability. For example, when attempting to measure the more effective mode of learning, many researchers seemed to equate short-term recall with learning. Such an assumption may not be justifiable.

Relationships Between Mode of Presentation and Learning

Although there have been many studies over the past 75 years to determine the more effective mode, auditory or visual, for presentation of material to be learned, there have not been any universal findings which indicated that one method of presentation was better than the other for all individuals or for all types of material. Results of earlier studies were interpreted to indicate that older subjects learned material which was presented visually better while younger subjects learned material presented aurally better (Day and Beach, 1950; Hawkins, 1897; Russell, 1928). Interpretations of later studies have suggested that the type of material used for presentation as well as the "recency" effect may have been important variables which influenced these generalizations (Craik, 1969; Corsini, Jacobus, and Leonard, 1969; King and Muehl, 1965; Murdock, 1969, 1969).

Most studies equated memory tasks with learning. That is, material was presented either visually or orally and the amount or rate of learning was designated as either the amount of material recalled or as the number of trials necessary for complete recall. Also, most studied emphasized short-term memory tasks.

Munsberg (1894) conducted the earliest study using subjects other than the examiner, which attempted to determine the more effective mode of presentation for learning. He presented colors, digits, or a combination of both to five adult subjects. He concluded that for all subjects the visual memory was stronger than aural memory when only one type of stimuli was presented. He also stated that when the two senses acted together, that is, when the material was presented for both visual and aural learning, the two memories appeared to hinder each other.

Hawkins (1897) presented nonsense syllables visually and/or orally to determine whether auditory or visual memory was the stronger. He used seventh-grade students, commercial-school students, and college students as his subjects in order to determine the interaction of mode with age. He concluded that the younger students recalled more from material presented orally; however, high school and college students recalled more from visually-presented material.

A similar experiment was performed by Russell (1928). His results were similar to those of Hawkins. He read material to his subjects, students in fifth, seventh, and ninth grades or presented the material for them to read. He concluded that students in grade five learned more when the material was read to them; students in grade seven did equally well whether they read the material or it was read to them; and, a slight advantage was demonstrated by the students in grade nine when they read the material. Later studies by Murray (1968), Otto (1961), and Rosenbusch and Gardner (1968) led to similar conclusions.

Day and Beach (1950) summarized the various findings of the studies undertaken before 1950 to determine the relationships between mode of presentation and learning. They concluded: 1) as intelligence and reading level increase, visual presentation became more effective; 2) relative efficiency of visual presentation increased with age from inferiority at six to possible superiority at sixteen; and, 3) visual presentation was better than oral presentation for more difficult material.

Interpretation of recent research results has indicated that these earlier findings and conclusions could not be considered as unequivocal. Although using slightly different tasks and measuring delayed recall as well as immediate recall, no significant differences were found between oral or visual presentation or that oral presentation was more effective in a paired-associates task employing older subjects

(Beery, 1968; Jensen, 1971; Tallmadge and Shearer, 1971).

Since 1960, studies which investigated memory storage indicated that verbal processing may be a more important variable than the mode of presentation (Sperling, 1963) and later items presented have a higher probability of being recalled than earlier presented items (Craik, 1969). This "recency effect" was more pronounced in orally presented materials than in visually presented ones (Craik, 1969).

Studies designed to measure the limits of short-term memory storage also have demonstrated a relationship between the mode of presentation and memory. Short-term auditory-memory storage was superior to visual memory when digits (Conrad and Hull, 1968; Margrain, 1967) or words (Murdock, 1968) were employed as stimuli. These results differed from the earlier studies in which visual memory was demonstrated as superior to auditory memory in older subjects.

In the theoretical review for his experiment, Craik (1969) delineated three positions which explained difference in modality for short-term storage. One position theorized that orally-presented items were encoded easily into short-term storage. A second theoretical position (Murdock, 1969) held that the retrieval of information was from modality-specific stores. The third position was similar to Neisser's (1967) echoic- and iconic-memory stores but included post-recognition, short-term storage which was neutral in regard to input. Craik (1969) explained the superiority of the auditory-recency effect as a result of information which was available in both post-recognition, short-term storage and in the echoic memory.

The type of stimuli presented to younger subjects may have been another variable which had not been accounted for in the conclusions drawn in the earlier studies. Although some studies indicated that auditory presentation was better than visual for younger subjects (Murray and Roberts, 1968; Otto, 1951; Rosenbusch and Gardner, 1968; Russell, 1928), other studies indicated that the type of stimuli employed may have influenced the results. Corsini et al. (1969) and King and Muehl (1965) presented both pictures and simple words to kindergarten children as a learning task. Both concluded that serial recall was better after presentation of pictures than after words ($p < .05$). These results, may be interpreted to mean that stimuli with which the child may be familiar and which did not require reading may have made both orally- and visually-presented stimuli equivalent in difficulty for young subjects. These findings and implications might explain, at least in part, the earlier difference found between the efficiency of younger and older subjects on different modes of presentation of the stimuli.

Cultural influences may be a third confounding factor affecting the results of studies which attempted to determine the more efficient mode of presentation of materials. Blank (1968), Bruininks (1969), and Williams (1970) presented evidence that cultural patterns may influence learning. Their studies allow for the conclusions that disadvantaged children appeared to learn better when material was presented visually than when it was presented orally.

Summary: Once educators could say, with some assurance and with research to back their conclusions, that younger subjects learned material presented orally better than visually-presented material and that older subjects retained more when the stimuli were presented visually. These statements are no longer supported universally by recent research findings. Recency effects, type of stimuli, and cultural factors have been demonstrated to influence learning and memory.

Individual Learning Types

As an extention of concern about the more effective method of presentation of stimuli for learning, other researchers were turning their attention to answering questions concerning interaction between individual proclivities and method of presentation. These researchers attempted to discover whether an individual could be classified as either a "visile" or "audile" learner.

The earliest studies in this area were concerned with interactions among mode of presentation, recall of stimuli, and individual learning types. In Whitehead's study (1896), 13 adult subjects were asked to memorize nonsense syllables which were presented visually or orally. He concluded that some individuals learn more rapidly through one mode than the other.

In his review of the earlier studies, Henmon (1912) pointed out that the weaknesses of earlier experimental designs made it impossible to draw conclusions concerning learning proclivities because of variations in the methods of presentation, the type of material, the imagery of the learner, and the procedure used. He pointed out that to determine distinctive imagery types, it was necessary to compare a single subject's performance under the differing conditions. In his experiment, psychology students learned lists of two-place digits and nonsense syllables. For analysis of learning strength, Henmon compared the number of repetitions necessary for complete and accurate learning in one mode against the other mode. He reasoned that those who scored above the mean in one mode should score below the mean in the other mode if there were distinct learning types. He concluded that superiority in one form of presentation meant practically the same degree of superiority in the other mode. Thus, Henmon did not find that distinct learning types existed.

Both O'Brien (1921) and Worcester (1925) drew similar conclusions when using adult subjects. They concluded that those who learn easily by one method also learn easily by the other.

In contrast, Winer, Wepman, and Morency (1965) when trying to develop and standardize a test of visual discrimination used subjects six- through eight-years old, concluded that there were differences in learning types related to the ability to use visual or auditory channels to gain information. They based this conclusion on the low correlations (r = .12 and .19) between auditory and visual discrimination. However, discrimination tasks do not require the associational learning skills as did the tasks in the aforementioned studies.

Jensen (1971) used 150 undergraduate students in a study designed to be a final clarification of memory types. He tested the subjects for immediate and delayed recall of digits under four experimental conditions: auditory-auditory, visual-visual, auditory-visual, and visual-auditory. That is, those receiving the two visual treatments or the two auditory treatments served as control groups to measure the test-retest reliability of the stimuli employed. Those receiving both auditory and visual treatments served as the experimental groups. Although finding significant interaction between modality and recall, Jensen was unable to find any significant interaction between modality and subject. Immediate recall was superior for auditory presentation ($p < .05$) and visual presentation was found superior for delayed recall ($p < .001$). Jensen concluded, ". . . any source of individual differences in visual or auditory memory would be in the effectiveness with which the subject transformed visual input into an auditory trace."

Summary: Although studies indicated that there was some interaction between mode of presentation and recall, studies which looked for individual's performance under differing conditions did not find any evidence that there were significant results to indicate that certain individuals recalled stimuli presented in one mode more effectively than in the other mode. However, this study is concerned more with learning tasks than recall.

Perceptual Differences Between Good and Poor Readers

In an effort to understand more about the nature of reading disability, many researchers measured perceptual abilities in good and poor readers and looked for differences in performances between these groups. Some authors chose to measure and evaluate discrimination abilities; some chose to measure memory; others chose to measure figure-ground perception; others to evaluate motor skills; and, still others to compare abilities on "cross-modal" transfer skills. Although using a variety of definitions and ways of measuring perceptual abilities, most studies indicated that poor readers did less well than did the good readers. However, few studies looked at children in the early stages of reading acquisition and followed the group longitudinally to determine whether there were differences in perceptual abilities before reading instruction began which were related to later reading achievement.

Auditory Abilities

Bond's study (1935) comparing auditory abilities of blending, perception, and discrimination in good and poor readers was an early investigation into this area. He showed that discrimination ability differed in good and poor readers in favor of good readers. He concluded that instruction in phonics probably was inappropriate for students with poor auditory-discrimination ability.

Christine and Christine (1964) administered tests of auditory discrimination to 53 children in grades one through three and found that the performance of good readers differed significantly from that of poor readers ($p < .025$) in favor of good readers.

To test some of the assumptions in the administration and interpretation of the Auditory Discrimination Test (Wepman), Blank (1968) administered a similar type task to Israeli children. She found that the ability to discriminate and/or pay attention, and/or to make judgments did differ between good and poor readers ($F=21.8$, $p < .025$) in favor of good readers.

A study by Poling (1953) indicated that auditory-memory span also was a factor which was related to development of word-recognition skills and therefore may be related to reading disability.

Visual Abilities

In a review of the literature concerned with causes of reading disability, Vernon (1957) suggested that visual perception was the more important of the two modalities in acquisition of reading skills.

Goins (1958) administered 14 tests of visual-perceptual abilities to first-grade students. A factorial analysis indicated that the following tests were related significantly to reading: pattern copying (.93), pattern completion (.79), reversal (.69), and picture squares (.56). Goins suggested that these tests probably were tasks which indicated strength of visual closure. Therefore, Goins concluded that visual closure was related to reading achievement.

Rusch (1971) found that in a sample of first grade children, good readers scored significantly higher on a test of visual closure than did poor readers ($F=7.16$, $p < .01$). He concluded that there may be validity to the claim that a test of visual closure may assess intellectual functioning with respect to reading disability at an early age.

Visual-Motor Skills

Researchers also concerned themselves with the relationship between reading skills and visual-motor abilities. Walters (1961) tested 35 second graders on a Memory for Designs Test, she found significant differences between the number of poor test performances drawn by good and poor readers. A Chi Square analysis showed significant differences beyond the .01 level in favor of good readers making better designs.

In other studies concerned with visual-motor skills, Fuller (1964) and Eastham (1968) demonstrated that there were differences in performance between good and poor readers on the required tasks. Eastham felt that the differences were so significant he recommended that visual-motor tests should be used with intelligence tests as predictors of school achievement.

Exploring differences in the ability of good and poor readers to see figure-ground relationships, Higgens and Gage (1968) and Stuart (1967) compared performances on the test of Witkins Embedded Figures. Again, significant differences were found in favor of good readers. Stuart used seventh- and eighth-grade subjects; Higgens and Gage used college students as subjects.

In a learning task, Roberts and Coleman (1968) attempted to determine whether it was easier for good or poor readers to learn nonsense syllables visually or kinesthetically. They used boys nine through thirteen years old as subjects. The boys were to learn twenty-three letter nonsense syllables visually or kinesthetically. Retarded readers were shown to be less efficient in learning when the stimuli were presented for visual learning. Both groups did equally well in learning kinesthetically. However, good readers learned better visually than kinesthetically ($p < .01$).

In attempts to determine memory differences between good and poor readers, Dornbush and Basow (1970) and McGrady and Olson (1970) presented auditory or visual tasks to both types of readers. Dornbush's results were interpreted to indicate that there were no significant differences in recall performances between good and poor readers. She also indicated that there was an interaction between modality and rate of presentation: as rate decreased, auditory recall increased steadily ($p < .001$). For all subjects, auditory recall was better than visual recall ($p < .01$). These findings support the earlier studies which reported that auditory presentation was more effective than visual recall for younger subjects.

McGrady's study indicated that children with specific learning disability (SLD) had slower reaction times to stimuli, particularly on verbal subtests. The eight-year-old subjects with SLD had significantly more difficulty than the controls in every instance where visual symbols were used. Nine-year-olds had more difficulty in recalling stimuli than controls regardless of sensory modality tested.

Cross-modal Transfer

Recent studies concerned with the ability to transfer information between modalities have indicated that individuals differ in abilities in this area and that there are differences between performances of good and poor readers.

One of the first studies was conducted by Birch and Belmont (1965) in Aberdeen, Scotland. They tested all boys born in 1953 on their ability to transpose taped patterns similar to Morse Code to dots and dashes which were shown on a chart. The subjects were to choose a visual pattern from among three alternatives which represented the pattern they heard. Birch and Belmont demonstrated significant differences ($p < .001$) in auditory-visual integration between good and poor readers. Good readers appeared to do much better on this task than did poor readers.

Similar experiments by Beery (1967), Blank, Wagner, and Brider (1966), and Katz and Deutsch (1963b) resulted in conclusions similar to Birch and Belmont's. Blank, Wagner, and Bridger suggested that the differences shown between good and poor readers may be due to labeling ability rather than the ability to transfer the information across modalities.

Ford (1967) and Rudnick, Sterritt and Flax (1967) have demonstrated correlations between the various tests of auditory-visual integration or transfer and reading-achievement scores. These correlations, which ranged from .30 to .44 ($p < .01$ and $< .05$), appeared to be independent of intelligence.

In studies using first graders as subjects, Muehl and Kremenak (1966) showed that tasks of visual-auditory and auditory-visual transfer were related to final reading-achievement scores. Auditory-visual tasks correlated .44 and visual-auditory tasks correlated .27 with final reading-achievement scores of ($p < .05$).

In contrast to other studies in this area, Rodenborn (1970) concluded after testing 180 students in grades one through six, that auditory-visual integration was not an important correlate with reading achievement.

Summary: Most studies indicated that poor readers do tend to score less well than do good readers on measures of visual, auditory, and visual-motor skills as well as on tests which purport to measure cross-modal transfer.

Perceptual Differences in Firt-Grade Children

Although using differing measures and tasks of auditory and visual abilities, most researchers concluded that these abilities appeared to be predictors of reading-achievement scores at the first-grade level, especially when used with measures of readiness and intelligence.

Barrett (1965a), Gates (1939b), Lott (1966), and Mertens (1968) demonstrated significant relationships between tests of visual discrimination and reading achievement. In general, these correlations ranged from .23 through .83.

In a review of the relationship between auditory discrimination and beginning reading achievement, Dykstra (1966) concluded that there were " . . . generally reported small positive correlational relationships ranging from approximately .20 to .40" between the two.

Dykstra (1966) administered seven measures of auditory discrimination to 632 first-grade pupils. These measures correlated from approximately .18 through .42 with final reading-achievement scores. He concluded that girls were significantly superior to boys in the auditory-discrimination skills measured and reading-achievement scores (t ranged from 2.64 to 3.6; $p < .01$); auditory discrimination was related significantly to reading achievement, although leaving much of the variance unexplained; and, that the different auditory-discrimination tests required different tasks although purporting to measure the same skill.

Bryan (1964), Gill, Herdtner, and Lough (1968), and Shea (1968) demonstrated relationships between visual-motor skills and reading achievement. Gill et al., using the Frostig Test of Developmental Perceptual Abilities and a Modified Rod and Frame Test, were able to demonstrate sex differences between performances on these tests and reading achievement. The correlation coefficients between these tests and reading-achievement scores ranged from .29 through .46 for males and from .58 through .72 for females. Gill concluded that there was not a high correlation between the males' performances on the Frostig and reading-achievement scores but that the females' performances were significantly ($p < .001$) related to reading scores.

A study which attempted to predict reading failure was conducted by DeHirsch, Jansky, and Langford (1966). In this study, the authors tested 53 children born between September, 1955 and June, 1956. The children were tested before they entered first grade. The initial battery of tests included tests of behavioral patterning, modality patterning, gross-motor movements, fine-motor movements, laterality, body image, visual-perceptual patterning, auditory-perceptive patterning, articulatory stability, sentence development, and reading readiness.

At the end of first and second grade, the authors compared relative strengths in visual and auditory-perceptual areas and reading-achievement scores. They concluded that all children who rated as superior visual-perceptual subjects on tests (N = 3) in kindergarten achieved higher scores on reading tests at the end of second grade than did the other subjects. Of those subjects who were judged by their performance on the tests to be superior auditory-perceptual children (N = 9), only those who had intensive phonics training were able to read satisfactorily. Although these results may be indicative of interaction between reading achievement and perceptual abilities, the authors did not account for the variables of teacher effectiveness nor reading methodology which may have influenced these results.

Summary: Conclusions drawn by other researchers, Bryan (1964), Bruininks (1969), Feldman, Schmidt, and Deutsch, and Rudnick et al. (1967), suggested that auditory and visual-perceptual skills may be related more to acquiring early reading skills than later ones. They also concluded that intelligence and cognitive abilities may be more important factors than perceptual skills for acquiring the later reading skills.

Adapting Instruction to Modality Preference

The value of adapting reading instruction to modality or perceptual strengths of the learner was recommended by Wepman (1968) and others interested in clinical work. Although such procedures have been followed by many clinics, the efficacy of this practice has not been demonstrated repeatedly.

In his study to determine the teaching method or combination of methods for the most effective teaching of word-recognition skills to individuals, Mills (1956) developed tests for assessing the preferred learning method of the student. He taught words which were unknown to the learner by four different methods; visual, phonic, kinesthetic, and a combination of the three. At the end of this study, he concluded that the most efficient method of learning words differs with individual children. He suggested that there was no single method which was the most effective for all the children.

Bruininks (1970) attempted to assess the efficacy of matching teaching procedures to the perceptual abilities of second-grade disadvantaged boys. He administered six tests of auditory abilities and six tests of visual abilities to 105 subjects. Perceptual dominance was determined by subtracting the sum of the standard scores on the auditory subtests from the sum of the standard scores on the visual measures. He designated those with visual dominance as the upper 25% of the sample and those with auditory dominance as the lowest 25%.

Two female instructors then taught 15 unknown words by either a visual or phonic method. Subjects were assigned randomly to treatment, i.e. either visual before phonic or phonic before visual. During the second session, one week later, a different 15 words were taught by the second technique. Evaluation of learning was defined as the number of words recalled correctly immediately after treatment and one week later. Bruininks interpreted the results to indicate that immediate recall was significantly better than later recall for all subjects ($p < .001$). The other comparisons involving perceptual-dominance groups, method of teaching, and order, failed to reach significance. Finally, the visual method resulted in better performance for all subjects. That is, those whose scores indicated that they were of either auditory or visual dominance achieved significantly higher scores under the visual method of teaching in contrast to the auditory or phonic approach ($p < .01$).

The study by Daniel and Thacker (1971) was undertaken to identify children's modality preference and to compare the efficacy of these differences on learning material presented through the preferred and non-preferred sensory modality. They identified 45 children from 105 subjects, ages 7-5 to 8-8, as representing auditory preference, visual preference, or non-preference groups. Preference groups were composed of 15 subjects, each of whom had a preferred-mode age one year higher than their non-preferred mode age. For example, the Auditory-Preference Group contained 15 subjects whose auditory age exceeded their visual age. The authors failed to state how preference age was determined.

Two lists of eight consonant-vowel-consonant (CVC) trigrams were presented, one list visually and the other orally. Although the authors explained the procedure for presentation of the stimuli, they failed to explain the task required of the subjects. It appeared that either a spelling or word-recognition test was administered. They concluded at the end of this study that a child's preference for modality of stimulus input was an important variable which influenced learning. Although they generalized their findings to reading and to clinical procedures, no supporting data from their study were presented.

In a study which attempted to match culturally-disadvantaged subjects by modality preference with method of instruction, C. Smith (1971), used reading-achievement scores at the end of both first and second grade to evaluate the effects of that interaction. The Illinois Test of Psycholinguistic Abilities was used to identify preference in 608 subjects. Visual or auditory preference was determined by at least a twelve month difference between visual- and auditory-subtest scores. Seventy-two subjects were chosen as the sample. Initial Teaching Alphabet, Words in

Color, or a supplemental basal reader were the programs used as teaching materials. An analysis of variance at the end of second grade yielded no overall group or treatment effect.

Summary: Adaptation of instruction to the modality preference of subjects who already have had reading instruction, did not appear to be successful.

Modification of Initial Reading Instruction to Modality Preference

Only six studies were found which were concerned with the major problem of this study, interaction between modality preference and beginning reading-achievement scores. The earliest study was conducted in 1939 (Gates, 1939) and there was an approximate twenty-five year lag before researchers began to test some of the implications drawn by Gates. Some of these studies were conducted using whole classrooms of children; others used only small groups of children and adapted instruction for these. Most showed no significance in gains. However, all failed to describe the child which would be most likely to benefit from such a procedure, and, except for one, failed to relate the perceptual abilities to reading readiness.

Gates (1939) reported a study which was designed to analyze and standardize a battery for determining reading readiness. This battery consisted of different tests which measured visual discrimination and memory, rhyming ability, and knowledge of letter names and the sounds represented by the letters. Instruction in word recognition was differentiated within nine classrooms by using five treatments. The treatments were: use of basal readers; use of basal readers supplemented with phonics instruction; presentation of words as wholes; presentation of words as wholes supplemented with phonics instruction; and, pre-reading experiences of presenting whole words in charts, experience stories, and many books, then changing to a basal-reading program. There were two classrooms in the first two treatments and one classroom in each of the others.

Correlation coefficients were computed between the various subtests and reading-achievement scores under the various treatments. In general, these correlations ranged from -.07 through .77. Gates concluded that the value of any subtest to predict reading-achievement scores varied with the instructional methods used and the validity of the subtest to measure the abilities emphasized in learning. Thus, the interpretation of the results of this study indicated that instruction based on auditory and visual abilities of the learner may be important for success in learning to read.

Twenty-five years later, Harris (1965) attempted to test the hypotheses that first-grade students would benefit from instruction based on their stronger auditory or visual skill and that a student's aptitude for a method was dependent upon his perceptual strengths. More specifically, he suggested that children with low visual-perceptual abilities would benefit from instruction which stressed a phonic or kinesthetic approach as opposed to an approach which stressed visual abilities. Visual functioning was measured by two subtests of the Gates Readiness Test, visual discrimination and memory, and by an adaptation of the Bender Visual Motor Gestalt Test. In addition, auditory ability was assessed by performance on a rhyming subtest of the Gates Reading Readiness Test.

He assigned children with low scores to one of four groups:

1. Kinesthetic experimental: low visual, high Bender.
2. Kinesthetic control: low visual, equally low Bender.
3. Phonic experimental: low visual, higher Gates' rhyming subtest.
4. Phonic control: low visual, equally low Gates' rhyming subtest.

Harris did not define the terms "low," "equally low," or "higher."

Children were taught individually by their teachers during the regular conference time in the individualized-reading program which was the method of reading instruction used in the school. During these conferences, the teachers stressed the method of teaching word recognition which was suggested by the experimenter. The teachers did not know the results of the pretesting nor to which group, experimental or control, the student was assigned. This procedure was employed to prevent bias.

At the end of first grade, Harris using a regression equation based on an earlier pilot study, compared the reading-achievement scores attained with those predicted. The two "control" groups which were given special instruction did better than the experimental groups who had scored higher on the pre-tests which were considered relevant. Harris ascribed these results to poor instrumentation and chance. He concluded that because there was no evidence to demonstrate that the method had actually caused the results, obtained differences may have been the result of a Hawthorne Effect.

In a study by Robinson (1972), 448 first-grade students were grouped into categories of high visual-high auditory, low visual-low auditory, high visual-low auditory, and low visual-high auditory discrimination on the bases of their performance on three visual-discrimination tests and the Auditory Discrimination Test (Wepman). As the treatment, word-recognition skills were presented by an auditory method (Hay Wingo Reading Series) or by a visual method (Scott, Foresman Reading Series).

The auditory method produced superior reading and spelling achievement when compared with the visual method. Auditory learners (those with low visual-high auditory scores) who were taught by a phonics approach achieved significantly higher reading-achievement scores than did the other groups ($p = .06$). In general, those receiving instruction in the auditory method (phonics) achieved scores higher than those in the visual method regardless of the category to which the student was assigned originally.

Bateman (1968) measured the modality preference of students in eight first-grade classrooms before reading instruction began. The Illinois Test of Psycholinguistic Ability (ITPA) was used to indicate modality strength. An auditory method (Lippincott beginning program) and a visual method (Scott, Foresman Reading Series) were used as treatments.

A two-way analysis of variance of reading-achievement scores indicated that for the four placement classes (those placed according to modality preference), the auditory method was significantly superior to the visual method ($p < .01$). In reading achievement, method was considered to account for 14% of the variance and subjects for 7%. However there was no significant interaction demonstrated between subject and method. Therefore, adjusting instruction to perceptual preference did not appear to influence reading-achievement scores.

Cullinan's study (1969) was described as an exploratory investigation to determine the effectiveness of adjusting instruction to the modality preference of the individual. She administered the New York University Modality Test (NYUMT) to 106 first graders to assess their modality preferences. This test has several subtests: visual discrimination, word recognition, and form copying. The subjects attended one New York City public school and many were Puerto Rican.

After administration of the NYUMT, the subjects were assigned randomly to one of four experimental-treatment groups. Instruction in these small groups differed from the regular classroom instruction in the type of emphasis and the materials used for teaching word recognition. Words which occurred frequently in the subject's speech during play periods were taught by a phonics approach or a whole-word approach.

After 7 1/2 hours of special small-group instruction, reading achievement was evaluated with the Metropolitan Reading Achievement Test. A one- by three-way analysis of variance revealed that for the word-recognition section of the tests, none of the four groups differed significantly from each other nor from the control group. Therefore, Cullinan concluded that adapting instruction to the needs of the individual did not appear to improve reading achievement scores. However, the small amount of actual instructional time adapted to the learner's needs make such a conclusion questionable.

In his attempt to test for relationships between modality preference and reading achievement, Cooper (1971) used a modified Mill's Learning Methods Test to teach nonsense words to 15 good and 15 poor readers. The procedure involved teaching unknown words using four types of instruction: visual, phonics, kinesthetic, or a combination of methods. On the basis of this trial teaching, the teacher determined which method was best suited for teaching each student. Cooper's modification involved teaching nonsense words in each of the four ways instead of unknown real words. Cooper taught five different nonsense words in each of the four treatments. Twenty different nonsense words were used.

Cooper used a modified-repeated measures design, therefore, all groups received each of the treatments.

His questions were:

1. Are there differences in the learning modalities of good and poor first-grade readers?
2. Across all modalities do good and poor readers learn nonsense syllables equally well?
3. Across readers, do first graders learn nonsense syllables equally well by all modalities?
4. For all readers, is there a modality for learning nonsense syllables that is significantly superior to the other modalities?

Analysis of variance and covariance, using IQ as the covariate, were used to determine the major finding: good readers learned in fewer trials than did poor readers in all modalities except in visual presentation where no difference was found. In general, no modality was considered superior although a trend was found which indicated that retention was better for good readers when taught with the kinesthetic or combination method. The author concluded that modality preference appeared as an individual phenomenon.

Summary: In general, the studies which were cited measured perceptual abilities or modality preference before instruction began and then related these abilities to achievement at the end of first grade or at the end of a specific number of instructional periods. The results of most studies indicated that there was little value in adapting instruction to modality preference or were inconclusive as to its value.

The studies cited had several weaknesses: no single definition of modality preference, inadequate measures of modality preference, lack of control for IQ, and a short amount of actual instructional time. Furthermore, most of the studies failed to measure subskills in both aural and visual modalities or measured only one of the components of modality preference.

Although the results of their studies did not support such opinions, some of the authors stated in their conclusions and implications that there were indications that concentration on the learner's modality preference may lessen the chance of failure in the beginning stages of learning to read (Cooper, 1971; Gates, 1935).

CHAPTER 3

PROCEDURES

The major purpose of this study was to investigate the theoretical relationship between modality preference and reading-achievement scores. This theoretical position asserted that those with auditory preference would be more successful in learning to read than those with visual preference when instructional procedures emphasized the learner's auditory strengths; in contrast, those with visual preference would be more successful in learning to read than those with auditory preference when instructional procedures emphasized their visual strengths. More specifically, those with auditory preference were expected to be more successful in learning to read when teaching procedures emphasized forming symbol-sound-associations (phonics); those with visual preference were expected to be more successful in learning to read when teaching procedures emphasized learning words as whole units (whole-word approach).

Because neither developmental data nor norms were available describing modality preference, an ancillary purpose or step in the study was an exploratory investigation of the measurement and determination of modality preference within two groups of first-grade students. Modality preference was defined as performance on standardized and informal tests which appeared to assess some of its components. These components were discrimination, memory, and closure.

To test the assumption that reading instruction should be based on the auditory or visual characteristics of the learner, this study examined the relationships among the components used to define modality preference and reading-achievement scores under two different methods of reading instruction.

Purpose of the Study

Specifically this study attempted to answer the following questions which were related to understanding the interaction between modality preference and reading achievement:

1. Does consideration of modality preference make a significant difference for success in beginning reading?
    a. What is the relationship between modality preference and reading-achievement scores?
    b. Are children with auditory-modality preference more likely to succeed in a program which emphasizes phonics than are children with visual-modality preference?
    c. Are children with visual-modality preference more likely to succeed in a program which emphasizes the whole-word approach than are children with auditory-modality preference?
    d. Do differences in performance on auditory and visual measures differentiate between good and poor readers?

e. Are there significant differences in reading-achievement scores among those with various amounts or degrees of modality preference?

In addition, this study also considered the following related questions:

2. Do the whole-word and phonic-linguistic beginning-reading approaches demand differing perceptual abilities on the part of the learner?
3.. Do the distributions of modality-preference difference scores deviate significantly from normal distributions?
4. Do the children with the lowest reading-readiness scores differ in modality preference from those with the highest reading-readiness scores?

Population and Sample

The subjects for the study were most of the first-grade students enrolled in two private schools in which the principals volunteers to participate in this investigation. There was one classroom in each school. Both schools were located within the metropolitan area of Albany, New York.

One student was excluded from the sample in School 1 because he did not speak English when the study began. One student was excluded from the sample in School 2 because he was repeating first-grade and it was assumed that he had developed word-recognition skills. No subjects were excluded from the sample of either school because of failing the auditory- or visual-acuity tests. The final samples consisted of 34 children in School 1 and 28 children in School 2.

In the judgment of the principals, both schools were considered to represent middle-income populations. Examination of census-tract information (U. S. Census, 1970) revealed that the median number of years of schooling completed by the residents with the census tract of School 1 was 12.9; for School 2, the median was 11.9. The median income per family of the residents of the census tract for School 1 was $15,262; for School 2, the median was $10,178. Therefore, both schools apparently drew their students from middle-income populations.

School 1. As summarized in Table 1, there were 34 children in the sample of School 1; 17 boys and 17 girls. For this

TABLE 1

DESCRIPTION OF SAMPLES

	School 1 (Whole word)	School 2 (Phonics)
Children		
Boys (N)	17	15
Girls (N)	17	13
Total (N)	34	28
Chronological Age ($\bar{X}$)		
Months	76.5	76.2
I.Q.		
Mean	115.47	114.03
Standard Deviation	10.00	15.90
Reading Readiness		
Raw Score ($\bar{X}$)	64.58	70.80
Percentile Ranking ($\bar{X}$)	69	81

group, the mean scores were (1) chronological age = 76.5 months; (2) I.Q. = 115.47 (s = 10 points); and (3) reading readiness test raw score = 64.58 which was equivalent to a percentile ranking of 69. Thus, this group probably represented students of average chronological age but with better than average intelligence and reading readiness when entering first grade.

School 2. As summarized in Table 1, there were 28 children in the sample of School 2; 15 boys and 13 girls. For this group, the mean scores were: (1) chronological age = 76.2 months; (2) I.Q. = 114.03 (s = 15.9 points); and, (3) reading readiness test raw score = 70.8 which was equivalent to a percential ranking of 81. Thus, this group also probably represented students of average chronological age but with better than average intelligence when entering first grade.

An Overview of Data Collection and Design

This study was a case study of children within two first-grade classrooms each of which represented different approaches to teaching beginning reading skills (whole-word or phonics). The study was designed to measure relationships among the modality preference of the students, the method of reading instruction in the classroom, and reading-achievement scores at the end of first grade. The study was conducted from September, 1971 through May, 1972.

To aid in determining modality preference, six tests were administered to each student. Modality preference was determined by evaluation of performance on auditory and visual measures of discrimination, memory, and closure. Initial measures of modality preference were obtained at the beginning of first grade, October and November, 1971. The assessment schedule is presented in Table 2.

TABLE 2

ASSESSMENT SCHEDULE

Device	Date of Administration	
	Initial	Final
Identifying Measures		
Reading Readiness	September, 1971	
IQ	October, 1971	
Auditory & Visual Acuity	September, 1971	
Components of Modality Preference		
Visual Discrimination	October, 1971	May, 1972
Auditory Discrimination	October, 1971	May, 1972
Visual Memory	October, 1971	May, 1972
Auditory Memory	October, 1971	May, 1972
Visual Closure	Oct.-Nov., 1971	May, 1972
Auditory Closure	Oct.-Nov., 1971	May, 1972
Reading Achievement		
Vocabulary & Comprehension		May, 1972

In addition, identifying measures of age, sex, and reading readiness were collected for each subject. Demographic information was obtained from the U. S. Census Report.

During the school year, reading instruction within each classroom stressed a different method of presenting word-recognition skills. In the School 1 classroom, reading instruction stressed learning words as whole units. In the School 2 classroom, reading instruction stressed learning words by forming symbol-sound associations between letters or patterns and then blending these together to form the word. Thus, each classroom was considered to represent a different treatment.

Final assessment of modality preference was obtained at the end of first grade, May, 1972. The final measures of modality preference were obtained by measuring performance on auditory and visual tests of discrimination, memory, and closure. Whenever possible, alternate forms of the tests given at the beginning of the study were administered.

Reading achievement was measured by performance on a standardized test of reading achievement which was administered during May, 1972.

Statistical analyses involved determining relationships among the components of modality preference, or total modality preferences, and reading achievement. Because each classroom was considered to represent a different treatment and to control for differences in teacher effectiveness, analyses of data were performed separately for each classroom.

Instructional Procedures and Assessment of Subjects

The purpose of this section is to describe in detail the (1) instructional procedures; (2) assessment of sample characteristics; (3) assessment of modality preference; and, (4) assessment of reading achievement.

Instructional Procedures

In each classroom studied, a different approach to teaching word-recognition skills was employed. In School 1 the whole-word approach was emphasized; in School 2 the phonic-linguistic approach was emphasized. Because neither school had ever used either of the selected reading programs, the method was assigned randomly to the school.

All children took part in the reading instruction in their classroom. This instruction was given by the teacher who had been assigned to the first grade by the principal.

Before instruction began, the investigator met with the teachers to explain the study and the method of word-recognition assigned to the classroom. At that time, any questions pertaining to the study or other reading help which the teachers needed was discussed. The investigator also was available during the school year to serve as a resource person to the teachers. Classroom observations indicated that the teachers followed the procedures suggested in the teacher's manual for the programs employed.

School 1 (Whole Word). The whole-word approach stressed presenting words as complete units when introducing them for the first time. The words were used in sentences, identified as whole units, and configuration clues were presented. The stress was on remembering the word as a whole unit.

The Bank Street Readers (Macmillan, 1967) was chosen as the basal-reading program which best represented the whole-word approach. This series of readers was designed by the authors to delay the teaching of phonics until later in the first grade. The first-grade materials include a readiness program, a preprimer, a primer, and a first reader. In addition, pupil workbooks accompany each book.

School 2 (Phonics). The phonic-linguistic approach stresses presentation of words by having students form symbol-sound associations among and between letters or patterns. For example, after students are taught the symbol-sound association for the pattern at, they learn words containing that pattern, fat, hat, cat, etc. Words which did not contain a phonogram or pattern were taught as whole words. The instruction stressed recognizing and remembering symbol-sound patterns and blending these together to decode words.

The Palo-Alto Reading Program, Sequential Steps in Reading (Harcourt Brace Jovanovich, Inc., 1968), was chosen as the program which best represented the phonic-linguistic approach. The materials for the first grade include seven story books accompanied by pupil-practice pads.

Assessment of Sample Characteristics

Tests of visual and auditory acuity, intelligence, and reading readiness were administered to all subjects. Directions which accompanied each test were followed exactly during each testing session. Most tests were administered in a quiet room provided by the school. The investigator, a trained assistant, or the classroom teacher administered all tests.

These tests were administered during the beginning of the school year (September, 1971) and were not readministered at the end of the study.

Acuity. Individual screening tests of auditory and visual acuity were administered to ascertain whether the students were able to participate in regular classroom instruction. Children who failed to perform satisfactorily were referred to the school nurse. One child in each school failed the auditory-acuity test. Because their physicians did not request special instructional procedures for these subjects, they remained as part of the sample. None of the subjects failed the visual-acuity test. Therefore, it was assumed that all subjects had a satisfactory level of auditory and visual acuity to take part in regular classroom instruction.

Intelligence. Administration of an individual-intelligence test, Slosson Intelligence Test for Children and Adults was begun during October, 1971. Because of pupil absences and school schedules, testing continued for several months. Intelligence quotients were computed against actual age norms, therefore the possible effect of the span of testing time was minimized.

Reading readiness. A standardized group test to assess readiness, Lee-Clark Reading Readiness Test, was administered to the students during the second and third week of school, September, 1971. To assure validity, the test was administered to small groups by the investigator or the classroom teacher. The regular classroom teacher administered either sections or the complete test to those who were absent during the regular testing session.

Sociometric measures. Demographic information used to assess some of the sociological characteristics of the samples was obtained from examination of census information. The investigator determined characteristics which were used as indicators of social class and gathered the relevant data from the census tracts in which each school was located (Report of the U. S. Census Bureau, 1970 Census).

Assessment of Modality Preference

To assess initial modality preference, six types of tests were administered to each student. These were tests of discrimination, memory, and closure presented to assess performance in both auditory and visual modalities. Depending on the task, tests were administered either individually or in small groups by the investigator or a trained assistant.

Testing was undertaken and completed during October and November, 1971. Students who missed any testing sessions were tested at the convenience of the investigator and the teacher.

Measures similar to those administered initially were administered at the end of first grade. Again, tests were administered to individuals or to small groups depending on the nature of the task.

In both initial and final testing, the order of test administration was the same: first, discrimination; next, memory; and, finally, closure. Both auditory and visual measures in the same component were assessed before administering the tests in a different component. For example, both auditory- and visual-discrimination tests were administered to students before the auditory- or visual-memory tests.

For most of the tests, directions which accompanied the forms were followed exactly. Any deviations from the standard directions will be explained in the section of this chapter entitled "instrumentation."

During initial testing, half the boys and half the girls within each classroom were administered the auditory tests in each component before the visual ones. For example, half the subjects were presented with the auditory-discrimination test before the visual-discrimination test; the other half were administered the visual-discrimination test before the auditory one. When analyses of initial data failed to show any significant interaction between sex or order, this practice was omitted from final testing procedures.

Assessment of Reading Achievement

A standardized test of reading achievement, the Gates-MacGinite Reading Test, Primary A, Form 1, was administered to all subjects in May, 1972. This test was administered to obtain a general measure of reading achievement which was independent of the materials used to teach the word-recognition skills.

Instrumentation

This section describes the standardized and informal tests administered to each of the subjects in this study. Directions for administration of the tests are explained only when the procedures used during this study differed from the standardized procedures.

Readiness

As a measure of general reading readiness, the Metropolitan Readiness Test (Harcourt Brace Jovanovich, Inc., 1964) was administered. This test was devised to measure the extent to which the child had ". . . developed for first-grade instruction," (manual, p. 3). All the following subtests were administered: word meaning, listening, matching, alphabet, numbers, and copying. The test manual reported intercorrelations among subtest scores ranging from .40 through .64. Predictive validity using the Metropolitan Achievement Test total score was reported as .65; test-retest reliability for the total score was .91 (Hildreth, Griffiths & McGauvran, 1964).

Reading Achievement

The *Gates-MacGinitie Reading Test*, Primary A, (Teachers College Press, 1965) was chosen as a measure of general reading achievement. This test yields scores in vocabulary and comprehension. Test-retest reliability coefficients of .91 for vocabulary and .94 for comprehension were reported (Gates & MacGinitie, 1965). May norms were used for converting raw scores to the normalized scores.

Intelligence

An intelligence quotient was obtained through the administration of the *Slosson Intelligence Test for Children and Adults* (Slosson Educational Publications, 1963). This is an individually-administered, short-screening test in which the items are similar to the *Stanford-Binet Intelligence Test* items. A test-retest reliability coefficient of .97 and concurrent validity of .93 with the Stanford-Binet were reported for six-year-olds (Slosson, 1963).

Auditory Acuity

Auditory acuity was assessed by performance during an individual screening test using the Maico Audiometer *Sweep Check Test* at 35 db (ISO).

Visual Acuity

Visual acuity was assessed by performance on the *Ready to Read Survey Test* using the Telebinocular (Keystone Vision Co.).

Auditory Discrimination

Auditory discrimination was assessed by an individual administration of the Auditory Discrimination Test (Wepman, 1958). This test consists of 40 pairs of words: Ten pairs are identical; and, 30 pairs differ in one phoneme. The subject must determine whether the pair of words presented orally by the examiner are the same or different. Two forms are available. The correlation between the two forms was reported as .91 (Wepman, 1958).

This test was chosen because it was often cited in the literature as the standard test used for assessment of auditory discrimination.

To assure validity of the test results, the subject's knowledge of the concepts of "same" and "different" was evaluated before testing began. Six color illustrations of simple and familiar items were placed on a table in front of the subject. Four of the illustrations were of two pairs of identical objects. The remaining two illustrations were of different objects. The student was asked to choose two pictures which were the same and two which were different. To test further the subject's knowledge of the concepts of "same" and "different," sample items in the directions for the Auditory Discrimination Test were administered orally. All students were able to perform satisfactorily on the sample tasks. Therefore it was assumed that they had the prerequisite understandings required by the task.

Visual Discrimination

Visual-discrimination scores were computed by summing correct responses on subtests one, two, and four of the Lee-Clark Reading Readiness Test (California Testing Bureau, 1962). These subtests were chosen because of the emphasis on discrimination of letter and word forms. This type of discrimination had been shown to be a better predictor of reading achievement than discrimination of geometric shapes (Barrett, 1965). Test-retest reliability coefficients ranging from .86 through .88 were reported (Lee & Clark, 1962).

The measure used for final assessment of visual discrimination was changed because 25 of the 34 students in School 1 and 21 of the 28 students in School 2 made 40 or more correct responses of a possible 44 on the Lee-Clark Reading Readiness Test. The final measure of visual discrimination was taken from the Katz and Deutsch study (1963 a). This task involved discrimination among similar word and word-like forms. This task appeared to be more difficult than the items used during initial testing. Neither reliability nor validity was reported (Katz & Deutsch, 1963 a).

Short-term Auditory Memory

Short-term auditory memory scores were computed by summing correct responses on the two subtests: Memory for Nouns and Memory for Sentences.

Memory for Nouns. This test assessed the subject's ability to remember, recall, and repeat eight nouns which were presented orally by the investigator. The words were presented at the rate of one per second. Before the presentation began the investigator told each student to try to remember as many of the words as he was able. After all nouns were presented, the subject was asked to recall the words. Order of recall did not have to match the order of presentation. Testing was terminated when the student failed to add another noun to his answer after a pause of one minute or indicated that he had finished. One point was awarded for each word recalled correctly.

The list of nouns was taken from the Katz and Deutsch study (1963 a) and is found in Appendix C. Neither reliability nor validity for this test was reported (Katz & Deutsch, 1963 a). This subtest also was administered at the end of the study.

Memory for Sentences. This subtest assessed the subject's ability to recall and repeat sentences of varying lengths and complexity. The subject was to repeat exactly each sentence which was read by the investigator. The subject responded after each sentence was presented. No deviations from the original were allowed in the scoring. All 20 sentences were presented to each subject. One point was awarded for each sentence which had been repeated exactly.

The sentences chosen were the first 20 sentences from the subtest of the Auditory Attention Span for Related Syllables of the Detroit Test of Learning Aptitude (Baker & Leland, 1959). A test-retest reliability coefficient of .95 was reported (Baker & Leland, 1959). Because only one form is available, this subtest was repeated during final testing.

Short-term Visual Memory

Short-term visual memory was assessed by performance on two subtests: Memory for Pictures and Memory for Word Forms. This score was computed by summing the correct responses on these two measures.

Visual Memory for Pictures. The Memory for Pictures subtest consisted of presentation of color illustrations of eight familiar objects at the rate of one per second and allowing one second for each stimulus to be shown. This rate of presentation was chosen to correspond with the rate of the verbal presentation of Memory for Nouns subtest. The pictures of the objects chosen differed from the words used in the auditory subtest of Memory for Nouns.

Before the presentation began, the investigator told each subject to try to remember the names of as many of the pictures as he was able. Subjects were not required to remember the sequence of presentation. When all eight items had been presented, the subject was asked to recall the names of as many pictures as he could. Testing was terminated when a subject failed to add another noun to his recall after a pause of one minute or indicated that he was finished.

Scoring was the number of correct responses regardless of the sequence in which they were presented. Any acceptable synonym was scored as a correct response. For example, some subjects responded with doll when shown a picture of a girl and this was scored as a correct response.

This test was suggested by the Katz and Deutsch study (1963 a) and was designed by the investigator to parallel the auditory test, Memory for Nouns. Neither reliability nor validity was assessed. Only one form was available. The complete directions and words used appear in Appendix B.

Short-term visual Memory for Word Forms. Visual memory also was measured by a subtest of the *Gates Reading Readiness Test* (1939). The task required that subjects look at a word stimulus presented for five seconds, remember the word form, and after the word was removed from view, choose it from among three words of similar configuration. Although visual-discrimination ability was required for this task, it was considered primarily as a measure of the subject's ability to hold a word form in mind for a short duration because the stimulus was removed from view. This subtest was one of the few standardized tests available for assessing this ability. One point was awarded for each correct word chosen by the subject.

A test-retest reliability coefficient of .78 and a correlation with reading ability of .81 were reported (Gates, 1939). Because only one form of this test is available, it was readministered at the end of the study.

Auditory Closure

Auditory-closure scores were computed by summing the correct responses on the auditory-closure subtest of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, & Kirk, 1968). The task requires the subject to supply the completed word for a stimulus word presented with sounds missing within that word. This test was administered individually with the stimuli presented on tape. The tape was recorded from the examiner's sample record which accompanies the ITPA kit. All subjects were presented with the 30 items. One point was awarded for each word which was reconstructed correctly. Because only one form is available, it was readministered at the end of the study.

Neither reliability nor validity coefficients is presented in the manual of directions which accompanies the test (Kirk et al., 1968).

Visual Closure

Visual-closure scores were obtained by summing the number of the plates in which final closure was achieved on the ten scales of the Threshold of Visual Closure test (Higgins & Wertmen, 1968). This test consists of ten scales and a demonstration scale. The first plate within each scale has a limited number of line clues of a drawing; successive plates present more pictorial clues until the last plate in each scale shows a black silhouette of the completed object. Final closure scores were defined as the number of the first plate on which the subjects identified correctly the object on three successive plates. All scales were presented to all subjects. Form I was administered during initial testing. Form II was administered during final testing.

Correlations between Form I and Form II are given as .59 through .62 for six-year-olds in the norming population. No significant differences were found between the means of Form I and Form II for six-year-olds (Higgins & Wertman, 1968).

Data

The purpose of this section is to review the types of scores collected for each subject and the method of converting these scores into the measures used for the statistical analyses. This section is divided into three parts: (1) review of types of data collected, (2) conversion of data; and (3) determination of modality preference including enabling procedures.

Types of Data

The following data were collected for each subject: identifying characteristics of age, sex, and IQ; reading-readiness scores; scores on tests of auditory and visual measures of discrimination, memory, and closure; and, reading-achievement scores on the vocabulary and comprehension subtests of the standardized-reading test.

Conversion of Data

Reading readiness. Reading-readiness scores were reported as raw scores. Most of the analyses involving the use of these scores were computed with raw scores. Rankings determined from these raw scores were used to designate those with the highest or lowest readiness scores within their group.

Discrimination. Scores on tests of the auditory and visual measures of discrimination were converted from raw scores to standard scores (z scores). A subject's raw score was the sum of correct responses on both same and different items. The standard scores were obtained by comparing a subject with others within his own classroom and were used in determining modality preference.

Memory. Scores on auditory and visual measures of memory were converted from raw scores to standard scores (z scores). These standard scores were obtained by comparing a student with others within his classroom and were used in determining modality preference.

Auditory-memory scores were obtained by summing the correct responses on the Memory for Nouns and Memory for Sentences subtests. Visual-memory scores were obtained by summing the correct responses on Memory for Nouns and Memory for Pictures subtests.

Closure. Scores on the auditory and visual measures of closure were converted from raw scores to standard scores (z scores). These standard scores were obtained by comparing a student with others within his classroom and were used in determining modality preference.

Reading achievement. Reading-achievement raw scores were converted to normalized scores reported in the directions which accompanies the test (Gates & MacGinite, 1965). May norms were used. The test authors recommend the use of these normalized scores rather than grade-level scores (Gates & MacGinite, 1965) as equal-interval measures. Both word-recognition and comprehension scores were used in the analyses.

Determining Modality Preference

Each student was administered six tests. There were tests of discrimination, memory, and closure in auditory and visual modes. Each test score was converted to a standard score using the means and standard deviations within the sample. Then, a difference score within each of the three components (discrimination, memory, and closure) was calculated by subtracting the standard score in the auditory mode from the standard score in the visual mode. The difference scores were used to indicate the extent to which modality preference existed within individual members of this group for each of the three components.

$$\text{Difference Score} = z_v - z_a; \text{ where } z = \frac{X - \bar{X}}{s}$$

For example, to determine the individual's modality preference as indicated by the discrimination tests, the auditory-discrimination standard score was subtracted from the visual-discrimination standard score yielding a difference score. A difference score higher than zero indicated visual preference; a score lower than zero indicated auditory preference; and, a score of zero indicated no preference.

Similar procedures were followed to obtain difference scores in memory and closure for each subject. Thus there were six standard scores and three difference scores computed for each subject. These were standard scores in auditory discrimination, visual discrimination, auditory memory, visual memory, auditory closure, and visual closure; and, difference scores of discrimination, memory, and closure. The listing of the difference scores for each subject is found in Appendix A.

Total modality preference. To determine total modality preference, the three difference scores from the components of discrimination, memory, and closure were summed for each subject. The greater the divergence of an individual's scores from zero on the subtests within a modality, the greater the total preference for that modality. Thus, the total modality preferences of the subjects within each classroom formed a continuum where a positive sum of the standard scores in the components was interpreted to indicate visual preference; where, a negative sum was interpreted to indicate auditory preference.

Because neither developmental data nor norms were available to describe modality preference, the difference scores were computed as aids in determining the relationship between modality preference and reading-achievement and readiness scores. Therefore, it was necessary to determine whether the use of these difference scores indicating modality preference both in the components of modality preference and in total modality preference were appropriate to use in the statistical analyses.

Enabling procedures. Ferguson (1971) allowed the subtraction of standard scores providing that the two distributions were similar. Therefore, to compare distributions of standard scores on the auditory and visual measures of discrimination, memory, and closure, the Kolmogorov-Smirnov Two-Sample Test was computed for each distribution.

a. Results of the Kolmogorov-Smirnov Two-Sample Test were used to determine whether the two distributions could have been drawn from the same populations or whether the two distributions within the same component differed significantly in respect to location, dispersion or skewness. To reject the null hypothesis that there were no differences in the distributions of auditory and visual scores within each component, an accumulated frequency difference of at least 11 was necessary (Siegel, 1956). Because no cumulative frequency reached 11 in any of the distributions compared in either school, the null hypothesis could not be rejected ($p < .05$). Therefore, it appeared that the two distributions could be random samples from the same population in respect to descriptive measures and could be used as an aid in the statistical analyses.

b. A Wald-Wolfowitz Runs Test was calculated to determine whether the distributions used to find the difference scores differed in any way. Because the two classes were comprised of small numbers, N = 34 and N = 28, the correction for continuity was employed to approach an approximation to a continuous curve. This test involved making a comparison of the number of "runs" in each distribution. A run was defined as a sequence of scores from the same distribution when the auditory and visual distributions were put on one continuum from low to high scores. Therefore, the standard scores in the auditory- and visual-discrimination distributions within one school were placed on a continuum and the number of "runs" was counted. Similar procedures were followed for the memory and closure distributions within each school.

In each of the comparisons made, results were interpreted to indicate that the distributions within each of the components were not similar ($p < .05$). Therefore as indicated in Table 3, comparisons between the distributions of modality preference, auditory and visual measures of discrimination, memory, and closure, did differ in some way.

The purpose of comparing the distributions was to be able to interpret results of the statistical analyses computed using the difference scores as indicators of modality

TABLE 3

RESULTS OF THE WALD-WOLFOWITZ RUNS TEST

	School 1 (Whole Word)	School 2 (Phonics)
Component	t	t
Discrimination (Modified)	3.54 ***	3.37 ***
Discrimination (Wepman)	4.03 ***	2.83 *
Memory	3.29 ***	2.02 *
Closure	2.56 **	2.83 *

*$p < .05$
**$p < .01$
***$p < .001$

preference. The results of the Komogorov-Smirnov Two Sample Tests were interpreted to indicate that the distributions were not significantly different. Therefore, it appeared that use of difference scores would be acceptable. However, when a Wald-Wolfowitz Runs Test was calculated to determine whether the distributions were similar or drawn from the same population, the results were interpreted to indicated that there were disparities in all of these distributions of difference scores. Therefore, any results reported in this study which were calculated by using the difference scores used for determining modality preference were interpreted with care.

Analyses

The purpose of this section is to describe the statistical procedures and tests of significance which were used to answer the questions posed. This section is divided into parts corresponding to each question.

Question 1: Does consideration of modality preference make a significant difference for success in beginning reading?

a. What is the relationship between modality preference and reading achievement? To determine the relationship between modality preference and reading-achievement scores, correlation coefficients were computed. These correlation coefficients were computed between the normalized reading-achievement scores in both word-recognition and comprehension subtests and differences scores indicating modality preference in the components of discrimination, memory, and closure. Additional coefficients were computed between the word-recognition scores and total modality-preference scores. Two sets of these correlation coefficients, Pearson Product Moment and Partial *r* to control for intelligence, were computed.

Analyses were separated into relationships between reading achievement as indicated by word-recognition scores and reading achievement as indicated by the comprehension subtest scores. To determine whether the correlations obtained were significant, Fisher's Tables were consulted with degrees of freedom equal to N-2.

b. & c. Are children with auditory-modality preference more likely to succeed in a program which stresses phonics? Are children with visual preference more likely to succeed in a program which stresses the whole-word approach? To test this theoretical assumption, t tests were computed between the reading-achievement scores of those with visual and auditory preference. Total modality preference scores were used to indicate auditory or visual preference. That is, those whose total sum of difference scores in the three components was greater than zero were considered as having visual preference; those whose total sum of difference scores was less than zero were considered as having auditory preference. A score of zero indicated lack of preference within each school. Analyses were computed separately for normalized scores on the word-recognition and comprehension subtests. To determine whether the results were significant, a t table was consulted with degrees of freedom, N-2.

d. Do differences in performance on the auditory and visual tests differentiate between good and poor readers? To look for more specific interaction between visual and auditory abilities and reading achievement, a Kruskal-Wallis One-Way Analysis of Variance by Ranks (H) was calculated between variability or performance on the auditory and visual measures and ranks on the word-recognition subtest scores. The Kruskal-Wallis was chosen because the data could not meet the assumptions of randomization and equal intervals necessary for parametric statistics.

Subjects in each school were divided into four groups based on their performance on the auditory and visual measures in each component. These groups were designated as high visual-high auditory, low visual-high auditory, high visual-low auditory, and low visual-low auditory. Thus, subjects within each school were divided into groups defined by performance on the auditory and visual measures: scores of those who were above the mean on both measures were placed in the high-high groups; the scores of those who were above the group mean on the visual test but below the group mean on the auditory test were placed in the high-low group, etc. Standard scores were used to determine whether the subject's scores were above or below the mean.

Within the cells of the Kruskal-Wallis statistic were the rankings of the subject's normalized scores on the word-recognition or comprehension subtests. Separate analysis was undertaken for each of the components within each classroom. Thus, four statistics were computed with the Kruskal-Wallis One Way Analysis of Variance by Ranks for both word-recognition and comprehension scores.

A Chi Square table was used to determine whether the resulting H statistic was significant. Degrees of freedom was set as K-1.

e. Are there significant differences in reading-achievement scores among those with various amounts or degrees of modality preference? To determine whether ranks on the reading-achievement tests differed among groups with varied amounts or degrees of preference, a Kruskal-Wallis One-Way Analysis of Variance by Ranks ($\underline{H}$) statistic was computed. The subjects within each classroom were divided into four groups which were arbitrarily defined as Maximum, Middle, Minimum, and No Modality Preference according to the definitions given in Chapter 1. Two Kruskal-Wallis statistics were computed to determine whether the groups represented random samples from the same population. Rankings of the normalized scores on the word-recognition test were placed into one of the four cells described above. The same procedure was followed with the comprehension scores. To determine whether the resulting $\underline{H}$ statistic in each analysis was significant, a Chi Square table was consulted with degrees of freedom set equal to K-1.

Question 2: Do the whole-word and phonic-linguistic beginning reading approaches demand differing perceptual abilities on the part of the learner?

Correlation matrices were constructed to summarize the relationships among the auditory and visual measures and reading-achievement scores. Then, $\underline{t}$ tests for correlated samples were computed to determine whether there were significant differences between the correlations computed between reading-achievement scores and the auditory and visual measures within each school. Finally, Fisher's $\underline{r}$ to $\underline{z}$ transformations were computed to determine whether the correlations between the auditory and visual measures differed significantly between the two schools. To determine whether the resulting statistics were significant, a t table was consulted.

Question 3: Do the distributions of modality-preference scores deviate significantly from a normal distribution?

To determine whether the distributions of the difference scores used to indicate modality preference deviated from a normal distribution, measures of central tendency were computed. Statistical descriptions of the distributions involved calculating the mean, mode, range, standard deviation, kurtosis, and skewness for each distribution (discrimination, memory, and closure). To determine whether any of the resulting measures of kurtosis or skewness differed significantly from zero, the difference from zero of each of these measures was divided by its standard error. To determine whether the results were significantly different from zero, a t table was consulted with degrees of freedom set equal to 1.

Question 4: Do children with the lowest reading-readiness scores differ in modality preference from those with the highest scores?

To determine whether children who demonstrated lower reading-readiness scores than others within their group differed in modality preference from those with the highest scores, a 2 x 2 Fisher's Exact Probability Test table was constructed. The number of subjects who were classified within the four cells was determined by separating those with the 10 highest and the 10 lowest readiness scores into auditory or visual preference. On the basis of the raw scores on the Metropolitan Reading Readiness Test, those with the 10 highest scores were placed into a high-readiness group and those with the 10 lowest scores were placed into a low-readiness group. Within each of these classifications, students were subdivided further into auditory or visual preference based on total modality preference score. To determine whether one of the cells was significantly different from the others, a Table of Critical Values of D in the Fisher Test (Siegel, 1956) was used.

Level of Confidence

For all statistical analyses, probability was set at the .05 level of confidence to determine whether any resulting differences could be due to chance.

Summary

At the beginning of the school year, two classrooms of first-grade students were administered auditory and visual tests of discrimination, memory, and closure to aid in determining the modality preference of each student. Throughout the school year, reading instruction within each school represented a different emphasis in presenting the word-recognition skills, whole-word or phonic-linguistic approaches.

At the end of the first grade, a standardized measure of reading achievement was administered to the subjects in both classrooms. Tests of auditory and visual discrimination, memory, and closure also were readministered.

Both parametric and nonparametric statistical procedures were employed to answer the questions posed. Correlation coefficients were computed to determine the relationships between the measures used to determine modality preference and reading achievement.

In addition, t tests were computed to investigate differences in reading achievement between those within each classroom who were designated as having either an auditory or visual preference.

A Kruskal-Wallis One Way Analysis of Variance by Ranks was the third statistical procedure used. Categories were defined based on differential performance on the auditory and visual measures. The categories were designated as high visual-high auditory; high visual-low auditory; low auditory-high visual; and low visual-low auditory. Scores above the group mean were considered high schores; scores below the group mean represented low scores.

Next, a Kruskal-Wallis One Way Analysis of Variance By Ranks was computed to determine whether significant differences in achievement were found among those with various amounts or degrees of preference.

Correlation matrices were constructed to summarize the relationships among the initial and final measures of auditory and visual tests and reading achievement.

Measures of central tendency were computed to describe the distribution of modality-preference scores.

Finally, a Fisher's Exact Probability Test was employed to determine whether children with lower reading-readiness scores than others within their classroom also differed in modality preference.

CHAPTER 4

RESULTS

The primary purpose of this study was to explore the relationship between modality preference and reading-achievement scores. For the purposes of this study, modality preference was defined as performance on auditory and visual measures of three components of modality preference: discrimination, memory, and closure. As an indication of the direction of modality preference, a subject's standard score in an auditory measure was subtracted from his standard score in the visual measure of the same component. These standard scores were obtained from analysis of performance during initial testing. There were three difference scores computed from each subject's standard scores. These were difference scores for discrimination, memory, and closure. Then, a total modality-preference score was obtained for each individual by summing these three difference scores. For either a component score or for total modality-preference score, a positive score was interpreted to indicate visual preference while a negative was interpreted to indicate auditory preference.

It had been hypothesized that those with auditory-modality preference would be more successful in reading when instruction stressed phonics; whereas, those with visual-modality preference would be more successful when instruction stressed the whole-word approach. Two classrooms of first-grade students served as samples. Instruction within each classroom stressed a different method of presenting the word-recognition skills, whole word or phonic linguistic. Thus, the hypotheses could be explored within each method of instruction.

This chapter presents the results of the analyses of the data. It is organized according to the questions posed.

Question 1: Does consideration of Modality Preference make a significant difference for success in beginning reading?

1a. What is the relationship between modality preference and reading achievement? The reporting of these results is divided into three parts: (1) relationships between the components of modality preference or total modality preference and word-recognition scores; (2) relationships between components of modality preference or total modality preference and reading-comprehension scores; and (3) partial correlations between components of modality preference, total modality preference and reading-achievement scores.

(1) Relationships between components of modality preference or total modality preference and word recognition. Pearson Product Moment Correlation Coefficients were computed between the difference scores in each component and the

normalized vocabulary scores (May norms) to determine the relationships between word-recognition skills and modality preference. Because the vocabulary subtest required the subject to choose one word from among four words of similar configuration to identify an illustration, it appeared to measure word-recognition ability rather than understanding of word meanings and was interpreted in this way for the analyses of the data. Thus, correlation coefficients were computed between these word-recognition scores and component and total modality-preference scores. These correlation coefficients were calculated for each school separately and for the total group.

The correlation coefficients are presented in Table 4.

TABLE 4

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS:
MODALITY PREFERENCE AND WORD-RECOGNITION SCORES

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28	Total Group N = 62
Component			
Discrimination	.064	.136	.096
Memory	.269	.042	.153
Closure	-.323	.003	-.162
Total Modality Preference	-.017	.188	.074

A correlation coefficient of at least .337 for N=34 and .374 for N=28 was needed to demonstrate significant relationships. The results were interpreted to indicate that no significant relationships were found between word-recognition skills and the three components of modality preference or total modality preference in either school or for the total group.

In School 1 (Whole Word), the correlations ranged from .269 through -.323. None of the correlations reached the r of at least .337 (df=32, $p \leq .05$) necessary to demonstrate a significant relationship. Therefore, it did not appear that there was a significant relationship between word-recognition skills and modality preference when instruction stressed presenting words as wholes.

To determine the amount of variance shared between each of the components and word-recognition scores, the correlation coefficients were squared. Not more than ten per cent of the variance of the word-recognition scores could be accounted for by knowledge of any of the components of modality preference. Less than one per cent of the variance of the word-recognition scores could be accounted for by knowledge of total modality preference.

In School 2 (Phonics), the correlation coefficients ranged from .003 through .188. Because a correlation of at least .374 (df=26; $p \leq .05$) was necessary to demonstrate a significant relationship, there was no indication that modality preference was related significantly to word-recognition scores under a phonics approach.

To determine the amount of variance shared between each of the components of modality preference and word-recognition scores, the correlation coefficients were squared. The results indicated that not more than six per cent of the variance on the vocabulary test could be accounted for by knowledge of modality preference as measured by its components or total modality preference.

For the total group, School 1 and School 2 combined, the Pearson Product Moment Correlation Coefficients between the components or total preference and word-recognition scores ranged from -.162 through .153. None of the correlations reached the r of at least .211 (df=60; $p \leq .05$) necessary for significance. Therefore, no significant relationships were demonstrated.

To determine the amount of variance shared between the components measured and word-recognition skills, the correlation coefficients were squared. The results indicated that not more than three per cent of the variance on the word-recognition test could be accounted for by knowledge of modality preference or its components. Therefore, in general, it did not appear that this study was able to demonstrate significant relationships between the components of modality preference and word-recognition skills regardless of the method of instruction employed to teach word recognition. Because each school represented a different treatment, Fisher's r to z transformations were computed to determine whether the correlations between word-recognition skills and modality preference differed significantly between the schools. As summarized in Table 5, none of the t statistics computed reached at least 2.00 necessary to demonstrate significance ($p \leq .05$). Therefore, it was concluded that the correlation coefficients could have represented random samples from the same population and did not indicate significant differences in the relationships between three components of modality preference or total modality preference and word-recognition skills even though each school represented a different method of instruction, phonics or whole word.

TABLE 5

FISHER'S r TO z TRANSFORMATIONS: MODALITY PREFERENCE AND WORD-RECOGNITION SCORES

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28	t
Component	r to z transformation		
Discrimination	.064	.137	.271
Memory	.276	.042	.870
Closure	.335	.003	1.235
Total	-.017	.190	.770

(2) *Relationships between components of modality preference, total modality preference and reading comprehension*. To determine the relationships between the components of modality preference, total modality preference, and reading comprehension, Pearson Product Moment Correlation Coefficients were computed between the difference scores indicating modality preference, total modality preference scores, and the normalized scores on the comprehension subtest of the standardized reading-achievement test. As indicated in Table 6, the only correlation coefficient to reach significance (r = .429) was between total modality preference and comprehension scores in School 2 (Phonics).

TABLE 6

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS:
MODALITY PREFERENCE AND COMPREHENSION SCORES

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28	Total Group N = 62
Component			
Discrimination	.215	.176	.199
Memory	.196	.132	.167
Closure	-.325	.207	-.099
Total Modality Preference	-.002	.429 **	.159

** p ≤ .02

In School 1 (Whole Word) none of the correlations reached the r statistic of .337 ($p < .05$) necessary to demonstrate a significant relationship between comprehension scores and the components of modality preference or total modality preference. Therefore, it did not appear that modality preference was related significantly to comprehension scores when instruction stressed the whole-word approach.

To determine the amount of variance shared between each of the components and reading comprehension, the correlation coefficients were squared. Not more than ten per cent of the variance of the comprehension scores could be accounted for by variance in modality-preference scores.

in School 2 (Phonics), one correlation reached an r statistic of at least .374 ($p < .05$) necessary to demonstrate a significant relationship. The correlation coefficient computed between total modality preference ($r = .429$) and comprehension scores was significant.

To determine the amount of variance shared between each of the components and reading comprehension scores, the correlation coefficients were squared. The interpretation of the results indicated that eighteen per cent of the variance in comprehension scores could be accounted for by variance in total modality-preference scores. None of the components of modality preference accounted for more than ten per cent of the variance in comprehension scores.

Theoretically, it had been anticipated that the correlations would be higher between modality preference and word-recognition skills than between modality preference and comprehension scores. The acquisition of word-recognition skills would appear to rely more on teaching to the preferred modality than would comprehension skills. Comprehension implies the use of cognitive skills and acquiring specific comprehension skills as well as word-recognition ability. Therefore, it was anticipated that teaching to modality preference would be a more important factor for a perceptual task (word-recognition) than a cognitive one. However, in all but one comparison, the correlation coefficients between modality preference and comprehension scores appeared higher than between word-recognition scores.

For the total group, School 1 and School 2 combined, the Pearson Product Moment Correlation Coefficients ranged from -.099 through .167. None of the coefficients reached the r statistic of .211 necessary to demonstrate significance ($p < .05$). Therefore, it was concluded that total modality preference was not related significantly to reading comprehension scores regardless of the method of instruction.

To determine the amount of variance shared between each of the components of modality preference and comprehension scores, the correlations were squared. None of the correlations accounted for more than four per cent of the variance in the comprehension scores.

Because each school represented a different treatment and might have shown significant differences between the correlation coefficients computed between the components of modality preference and comprehension scores, Fisher's r to z transformations and statistics were computed. As summarized in Table 7, none of the resulting t statistics reached 2.00 necessary to demonstrate significant differences ($p < .05$). Therefore, it was concluded that the correlation coefficients could have been random samples from the same population in respect to relationships between modality preference and comprehension and probably did not reflect differences in the correlations between the components of modality preference or total modality preference and reading comprehension even though each school represented a different method of instruction, whole word or phonics.

TABLE 7

FISHER'S r TO z TRANSFORMATIONS: MODALITY PREFERENCE AND COMPREHENSION SCORES

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28	t
Component	r to z transformation		
Discrimination	.218	.178	.149
Memory	.198	.133	.242
Closure	.337	.210	.472
Total	-.002	.459	1.600

(3) *Partial Correlations between modality preference and reading-achievement scores*. Because intelligence has been cited as being related significantly to reading achievement (Harris, 1970), the relationships among total modality preference, intelligence, and reading achievement scores were explored. These relationships are shown in Table 8. Although the correlation coefficients between intelligence and reading-achievement scores were significant, the correlation coefficients between intelligence and modality preference were not.

TABLE 8

PEARSON PRODUCT MOMENT CORRELATIONS:

IQ, MODALITY PREFERENCE, AND READING-ACHIEVEMENT SCORES

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28
IQ X Modality Preference	-.172	-.023
IQ X Vocabulary	.665***	.608***
IQ X Comprehension	.544**	.513**
Modality Preference X Vocabulary	-.017	.188
Modality Preference X Comprehension	-.002	.429*

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

In order to explore further the relationships between modality preference and reading achievement, partial correlations were computed to assess these relationships while controlling the influence of intelligence. A partial correlation allows for demonstrating the relationship between two variables when their relationship is influenced by a third variable. These partial correlations are shown in Table 9.

When controlling for intelligence, the relationships between total modality preference and vocabulary scores as well as comprehension scores increased. However, only the correlation between modality preference and comprehension scores ($r = .513$, $p < .01$) in School 2 (Phonics) was significant.

TABLE 9

PARTIAL CORRELATION COEFFICIENTS:

MODALITY PREFERENCE AND READING ACHIEVEMENT SCORES

(IQ HELD CONSTANT)

	School 1 (Whole Word) N = 34	School 2 (Phonics) N = 28
Modality Preference X Vocabulary	.132	.254
Modality Preference X Comprehension	.111	.513**

**$p \leq$ 01

To determine the amount of variance shared between total modality preference, vocabulary scores, and comprehension scores when intelligence was held constant, the partial correlation coefficients were squared. In School 1 (Whole Word), approximately 1 per cent of the variance on the vocabulary and comprehension tests could be accounted for by variances in modality preference. In School 2 (Phonics), approximately six per cent of the variance of the word-recognition scores and twenty-six per cent of the variance of the comprehension scores could be accounted for knowledge of modality preference when intelligence was controlled through statistical procedures.

1b. Are children with auditory-modality preference more likely to succeed in a program which emphasized phonics than are children with visual-modality preference? To test the assumption that those with auditory-modality preference would be more successful than those with visual-modality preference when receiving instruction which stressed phonics, t tests were computed between the reading-achievement scores of the subjects in School 2 (Phonics). It had been suggested that subjects with auditory-modality preference would be receiving instruction in an approach (phonics) which was compatible with that preference. Therefore, they would learn to read more successfully than subjects with a visual-modality preference receiving the same phonics approach.

The normalized vocabulary scores were separated into two groups representing scores of those subjects who had been designated as having auditory or visual preference. The designation of auditory or visual preference was based on the total modality-preference score. Those with a positive score were considered to have a visual preference; those with a negative score were considered to have an auditory preference. Comprehension scores were separated in the same way. The results of the computations are presented in Table 10. There were significant differences between the means of the normalized reading-achievement scores of subjects with auditory- and visual-modality preference on both vocabulary ($\underline{t} = 2.12$, $p \leq .05$; df = 26) and comprehension ($\underline{t} = 3.25$, $p \leq .01$; df = 26) scores.

TABLE 10

RESULTS OF $\underline{t}$ TESTS: READING-ACHIEVEMENT AND IQ SCORES
OF SUBJECTS WITH AUDITORY OR VISUAL PREFERENCE
SCHOOL 2 (PHONICS)

Modality Preference	Auditory N=16		Visual N-12			
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$diff	t
Normalized Scores						
Word Recognition	40.87	8.90	49.33	11.49	8.46	2.12*
Comprehension	41.00	8.02	51.08	8.18	10.08	3.25**
IQ	111.37	14.46	117.58	17.65	6.21	0.99

*$p \leq .05$

**$p \leq .01$

The significant differences, however, were not in the expected direction. The mean scores of those with visual preference were significantly higher than the mean score of those with auditory preference on both the vocabulary and the comprehension subtests. Because there was no significant difference between the mean IQ scores of the two groups (t = .99), it did not appear that the differences in reading-achievement scores could be attributed to intelligence. Therefore, the interpretation of the results of this study did not support the assumption that those with auditory preference would be more successful than those with visual preference when reading instruction stressed phonics.

1c. Are children with visual-modality preference more likely to succeed in a program which emphasized the whole-word approach than are children with auditory-modality preference? To test the assumption that those with visual-modality preference would be more successful than those with auditory-modality preference when receiving instruction which stressed presenting words as wholes, t tests were computed between the normalized reading-achievement scores of the subjects in School 1 (Whole Word). Because of the demands made on the learner by this approach, it had been hypothesized that in this school, those with visual-modality preference would score significantly higher on the reading-achievement tests than would those with auditory-modality preference.

The normalized vocabulary and comprehension scores were separated into two groups representing scores of those subjects who had been designated as having auditory or visual preference. As summarized in Table 11, none of the resulting t statistics reached at least the 2.04 ($p < .05$) necessary to indicate significant differences in achievement. Because there was no significant difference in the means of the intelligence scores of the two groups, it did not appear that differences in intelligence was a significant factor influencing these results. Therefore, the interpretation of the results did not support the supposition that those with visual preference would be more successful than those with auditory preference in a whole-word approach.

TABLE 11

RESULTS OF t TESTS: READING-ACHIEVEMENT AND IQ SCORES OF SUBJECTS WITH AUDITORY OR VISUAL PREFERENCE SCHOOL 1 (WHOLE WORD)

Modality Preference	Auditory N=16		Visual N=18			
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$ diff	t
Normalized Scores						
Word Recognition	43.87	9.93	44.88	7.53	1.01	0.34
Comprehension	44.50	9.47	44.88	10.54	0.38	0.11
IQ	116.25	7.98	114.77	11.69	1.48	0.43

1d. Do differences in performance on auditory and visual measures differentiate between good and poor readers? To look for more specific interaction between auditory and visual abilities and reading achievement, a Kruskal-Wallis One Way Analysis by Ranks (H) statistic was computed. The subjects' rankings on the word-recognition test were placed into one of four columns which were separated to show differences in performance on the auditory and visual tests used in this study. These four columns were designated as high-high, high-low, low-high, and low-low. The first word of each designation within each column describes the standing of the subject in comparison with others within his group on the visual measure of a component of modality preference. The second word designates the standing of the subject on the auditory measure in the same component. The ranks of those whose scores were above the mean on both measures were placed in the high-high group; the ranks of those who scored above the group mean on the visual test but below the group mean on the auditory test were placed in the high-low group; the ranks of those who scored below the group mean on the visual measure but above the mean on the auditory measure were placed in the low-high grouping; and, the ranks of those who scored below the mean on both the auditory and visual measures were placed in the low-low group. For example, the ranks of those who scored below the mean on the visual-discrimination test but above the mean on the auditory-discrimination test were placed in the low-high group in the discrimination column. Ranks of the normalized scores for vocabulary and comprehension were placed into one of the above four categories for each of the three components, discrimination, memory, and closure. The lowest score was ranked one. Separate analysis was undertaken for each component within each school. A table summarizing the number of subjects within each category is found in Appendix E.

As summarized in Table 12, in School 1 (Whole Word) two of the resulting $\underline{H}$ statistics reached at least the 7.82 necessary to demonstrate significant differences. The results were interpreted to indicate that the four groups within the discrimination and memory components probably were not drawn from

TABLE 12

RESULTS OF THE KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS: WORD-RECOGNITION RANKINGS INTO CATEGORIES OF VISUAL AND AUDITORY SKILLS

SCHOOL 1 (WHOLE WORD)

	$\bar{X}$ Rankings on Word-Recognition Test				
Categories	High_v-Low_a	Low_v-High_a	High_v-High_a	Low_v-Low_a	$\underline{H}$
Component					
Discrimination	15.25	14.87	24.06	9.22	13.34**
Memory	20.12	16.50	23.04	9.96	10.97*
Closure	10.89	18.92	19.00	21.04	5.64

*p < .02
**p < .01

the same population in respect to word-recognition skills. There was a tendency for the group which represented high visual-high auditory skills to rank higher than those in the low visual-low auditory category on the word-recognition test.

In School 2 (Phonics), none of the $\underline{H}$ statistics calculated among the four categories reached the 7.82 necessary to indicate significant differences. As summarized in Table 13, it appeared that the four groups within each component could have been random samples from the same population in respect to rankings of word-recognition scores. Therefore, performance on the word-recognition test did not appear to differ among the groups representing differences in auditory and visual skills.

TABLE 13

RESULTS OF THE KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS: WORD-RECOGNITION RANKINGS INTO CATEGORIES OF VISUAL AND AUDITORY SKILLS
SCHOOL 2 (PHONICS)

	$\bar{X}$ Rankings on Word-Recognition Test				
Categories	$\text{High}_v\text{-Low}_a$	$\text{Low}_v\text{-High}_a$	$\text{High}_v\text{-High}_a$	$\text{Low}_v\text{-Low}_v$	$\underline{H}$
Component					
Discrimination	17.33	13.67	17.23	8.94	5.59
Memory	18.25	13.20	18.93	9.80	6.65
Closure	12.20	12.06	18.25	13.50	3.29

To determine whether differences in comprehension scores were due to differences in visual and auditory abilities, a Kruskal-Wallis One-Way Analysis of Variance by Ranks was calculated for each of the components of modality preference. Rankings on the comprehension test were placed into one of the four categories described in the above analysis. As shown in Tables 14 and 15 none of the resulting H statistics in either school reached the 7.82 ($p < .05$, df=3) needed to demonstrate significant differences. Therefore, it was concluded that the different categories within each school could have represented random samples from the same population in respect to comprehension scores. Performance on the comprehension test did not appear to differ significantly among the groups representing differences in auditory and visual skills.

TABLE 14

RESULTS OF THE KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS: COMPREHENSION RANKINGS INTO CATEGORIES OF VISUAL AND AUDITORY SKILLS

SCHOOL 1 (WHOLE WORD)

	$\bar{X}$ Rankings on Comprehension Test				
Categories	$High_v$-Low_a	Low_v-$High_a$	$High_v$-$High_a$	Low_v-Low_a	H
Component					
Discrimination	15.58	12.37	22.66	12.44	7.66
Memory	14.62	16.50	22.46	12.68	6.44
Closure	11.17	19.08	16.81	22.32	6.41

TABLE 15

RESULTS OF THE KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS: COMPREHENSION RANKINGS INTO CATEGORIES OF VISUAL AND AUDITORY SKILLS

SCHOOL 2 (PHONICS)

	$\bar{X}$ Rankings on Comprehension Test				
Categories	High$_v$-Low$_a$	Low$_v$-High$_a$	High$_v$-High$_a$	Low$_v$-Low$_a$	$\underline{H}$
Component					
Discrimination	14.58	12.67	17.91	10.44	3.96
Memory	19.50	11.00	18.21	10.65	6.69
Closure	16.70	12.55	15.80	12.87	1.22

1e. Are there significant differences in reading achievement among those with various amounts or degrees of modality preference? A Kruskal-Wallis One-Way Analysis of Variance by Ranks was calculated to determine whether there were differences in reading-achievement scores among those with differing amounts of modality preference. Amount of modality preference was arbitrarily divided into four categories: Maximum, Middle, Minimum, and No Preference. Maximum preference indicated that an individual scored at least one-half standard score higher in one modality than in the other in all three components used to indicate modality preference. Middle preference indicated that a subject's standard score was higher in one modality in two of the three components. Minimum modality preference indicated that an individual scored at least one-half standard score higher in one modality than in the other in one of the three components. No modality preference indicated that the difference score was less than one-half in all three of the components, discrimination, memory, and closure or whose scores were mixed. More complete definitions of each of these categories appear in Chapter 1.

Vocabulary and comprehension scores of the subjects were ranked and placed into one of the four cells designated by the above categories which indicated amount or degree of preference for that individual. Scores within each school were analyzed separately.

The results are presented in Table 16. Neither of the resulting statistics in School 1 (Whole Word) reached the $\underline{H}$ statistic of 11.1 (df=5) necessary to demonstrate significant differences among the categories. Because no subject was categorized in the minimum auditory-preference group, computations were performed for the remaining six categories. The $\underline{H}$ statistic calculated among these six groups for vocabulary rankings was 2.57 when adjusted for ties. The $\underline{H}$ statistic adjusted for ties among the rankings on the comprehension scores was 6.01.

Neither of the resulting statistics in School 2 (Phonics) reached the $\underline{H}$ of 9.5 (df=4) necessary to demonstrate significant differences among the categories. Because there were no

TABLE 16

RESULTS OF KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS:

DEGREE OF MODALITY PREFERENCE AND READING-ACHIEVEMENT SCORES

	$\bar{X}$ Rankings							
	Visual Preference			No	Auditory Preference			
	Max.	Mid.	Min.		Min.	Mid.	Max.	H
				Vocabulary Subtest				
School 1	14.00	15.71	21.83	18.37	00.00	15.83	28.50	2.57
School 2	00.00	15.14	11.33	19.36	10.00	12.67	00.00	4.15
				Comprehension Subtest				
School 1	15.75	14.00	27.33	19.71	00.00	13.78	23.00	6.01
School 2	00.00	17.28	9.00	19.92	8.10	13.00	00.00	8.42

Max. = Maximum modality preference

Mid. = Middle modality preference

Min. = Minimum modality preference

subjects categorized as demonstrating maximum auditory or visual preference, only five categories were used in the analysis. The H statistic adjusted for ties among the rankings on the vocabulary scores of the groups was 4.15. The H statistic adjusted for ties among the rankings on the comprehension scores was 8.42.

Therefore, it was concluded that the different groups within each school could have represented random samples from the same population in respect to reading-achievement scores. There did not appear to be any evidence from this study that reading-achievement score differed among those with different amounts or degrees of preference.

Question 2: Do whole-word and phonic-linguistic beginning-reading approaches demand differing perceptual abilities on the part of the learner?

The theory of teaching word-recognition skills in a manner which was compatible with the modality preference of the learner appeared to be based, in part, on the premise that success in reading instruction stressing phonics relied on auditory abilities while success in the whole-word approach relied on visual abilities. To test these assumptions, correlation matrices were constructed to summarize the relationships among the measures of auditory and visual abilities and reading-achievement scores. In addition, t tests for correlated samples were computed to determine whether the correlation between the reading-achievement scores and the auditory measures differed significantly from the correlations between reading-achievement scores and the visual measures for both the whole-word and phonic-linguistic approaches. Finally, Fisher's r to z transformations and statistics were computed to determine whether the differences were significant between the two schools on the correlations of some of the initial measures and subsequent reading-achievement scores.

2a. Intercorrelations among all variables. Correlation coefficients were computed to determine which measures were related significantly among the auditory and visual skills, and reading-achievement scores. The results of these computations are discussed in two parts: (1) intercorrelations among the variables in School 1 and (2) intercorrelations among the variables in School 2. All correlations are presented in matrices. The first 10 variables represent testing during the initial stages of this study; variables 11 through 20 represent testing of the variables at the end of the study; and, variables 21 and 22 represent correlations with the word-recognition and comprehension scores respectively. Initial and final testing variables refer to the correlations calculated with the raw scores collected during the assessment of visual discrimination, auditory discrimination, visual memory for pictures, visual memory for word forms, total visual memory, auditory memory for sentences, auditory memory for words, total auditory memory, visual closure, and auditory closure.

Intercorrelations among all variables in School 1 (Whole Word)

Table 17 shows the relationships among all the variables for the subjects in School 1. Many of the correlations reached the r statistic of at least .337 necessary to demonstrate significance ($p < .05$, df=32). Only the significant relationships between the auditory and visual variables and reading achievement will be discussed.

Significant relationships were demonstrated between the word-recognition scores and initial measures of total visual memory (r=.657), visual memory for words (r=.642), visual discrimination (r=.470), auditory memory for sentences (r=.451), auditory discrimination (r=.389), and total auditory memory (r=.381).

Significant relationships were demonstrated between word-recognition scores and the final measures of total visual memory (r=.490), visual discrimination (r=.423), and auditory discrimination (r=.340).

To determine the amount of variance in the word-recognition scores that could be accounted for by variance in the scores of the initial measures, the correlation coefficients were squared. Approximately 41% of the variance of word-recognition scores could be accounted for by variance on the initial measure of Visual Memory for Word Forms Test. Other than visual-memory variables, none of the correlations accounted for more than 22% of the variance.

TABLE 17

INTERCORRELATIONS AMONG ALL VARIABLES

SCHOOL 1 (WHOLE WORD)

	1	2	3	4	5	6	7	8
INITIAL MEASURES								
1. Vis. Dis.	1.0000							
2. Aud. Dis.	.1979	1.0000						
3. Vis. Mem. Pic.	-.0672	.3179	1.0000					
4. Vis. Mem. Word	.1976	.2521	.2705	1.0000				
5. Total Vis. Mem.	.1583	.3152	.5133**	.9641***	1.0000			
6. Aud. Mem. Sent.	.1116	.5319**	.3983*	.4326*	.4940**	1.0000		
7. Aud. Mem. Word	.0616	.1771	-.0518	.1744	.1515	.2301	1.0000	
8. Total Aud. Mem.	.1173	.5141**	.3138	.4299*	.4725**	.9269***	.5786***	1.0000
9. Vis. Closure	-.1548	.1734	.0396	.0775	.0820	-.0687	.0682	-.0313
10. Aud. Closure	-.0024	.0215	.2321	.1295	.1688	.1316	-.1139	.0663
FINAL MEASURES								
11. Vis. Dis.	.1591	.1819	.1397	.5829***	.5467**	.2020	-.0025	.1684
12. Aud. Dis.	-.0229	.2210	-.0082	.3161	.2706	.2691	.2826	.3346
13. Vis. Mem. Pic.	.0911	-.3227	.1511	-.0390	.0054	-.1250	-.1496	-.1625
14. Vis. Mem. Word	.2950	-.1672	.1976	.2241	.2522	.0755	.0112	.0676
15. Total Vis. Mem.	.4887**	.1886	.3645*	.5189***	.5653***	.4081*	.2589	.4419*
16. Aud. Mem. Sent.	.1131	-.2046	.2117	.0592	.1078	.0823	-.1329	.0178
17. Aud. Mem. Word	.0808	-.3429	.1079	-.0487	-.0165	-.1303	-.1537	-.1685
18. Total Aud. Mem.	.1549	-.0708	.2308	.0906	.1395	.2798	-.0434	.2178
19. Vis. Closure	.0657	.1476	-.0626	-.0407	-.0525	.0903	.1819	.1459
20. Aud. Closure	.0119	-.2672	.2859	.0733	.1405	-.0497	-.1025	-.0811
21. Vocabulary	.4698**	.3891*	.3170	.6422***	.6568***	.4512**	.0072	.3809*
22. Comprehension	.4789**	.2064	.0673	.5260***	.4843***	.3132	.0596	.2855

TABLE 17 Continued

	9	10	11	12	13	14	15	16
9. Vis. Closure	1.0000							
10. Aud. Closure	-.0090	1.0000						
FINAL MEASURES								
11. Vis. Dis.	.1481	.0508	1.0000					
12. Aud. Dis.	.1892	.2668	.2547	1.0000				
13. Vis. Mem. Pic.	.0152	.0639	-.0833	-.2376	1.0000			
14. Vis. Mem. Word	-.0278	.1047	.1569	-.0294	.8976***	1.0000		
15. Total Vis. Mem.	-.0546	.0727	.3245	.1988	.4706**	.7673***	1.0000	
16. Aud. Mem. Sent.	-.0293	.1449	-.0299	-.1343	.9676***	.9157***	.5390**	1.0000
17. Aud. Mem. Word	.0163	.0818	-.0696	-.2232	.9926***	.9004***	.4424	.9678***
18. Total Aud. Mem.	.0007	.1986	-.0335	-.0230	.8176***	.8475***	.5924***	.8950***
19. Vis. Closure	.1095	-.1482	-.1132	.2239	-.0170	-.0116	-.0088	.0112
20. Aud. Closure	-.0772	.4523**	.0567	-.0644	.8174***	.7681***	.4438*	.8260***
21. Vocabulary	-.1897	.2697	.4229*	.3403	-.1440	.1212	.4903**	-.0070
22. Comprehension	-.3204	.1417	.3643*	.2361	-.1641	.1130	.4292*	-.0598

TABLE 17 Concluded

		17	18	19	20	21	22
17.	Aud. Mem. Word	1.0000					
18.	Total Aud. Mem.	.8306***	1.0000				
19.	Vis. Closure	-.0178	.0134	1.0000			
20.	Aud. Closure	.8094***	.7159***	-.0137	1.0000		
21.	Vocabulary	-.1521	.0632	-.0506	.0853	1.0000	
22.	Comprehension	-.1554	-.0332	-.0042	.0137	.8223***	1.0000

* p ≤ .05
** p ≤ .02
*** p ≤ .01

The scores on the comprehension subtest were related significantly to the following initial-testing variables: total visual memory (r=.486), visual memory for word forms (r=.526), and visual discrimination (r=.478). None of the correlation coefficients computed between comprehension scores and the auditory variables was significant.

Significant relationships were demonstrated between the comprehension-subtest scores and the final measures of total visual memory (r=.429) and visual discrimination (r=.364). None of the other correlation coefficients computed was significant.

To determine the amount of variance in the comprehension subtest scores that could be accounted for by these relationships, the correlation coefficients were squared. Variances in the initial measure of visual memory for words accounted for approximately 28% of the variance. The final measure of total visual memory accounted for approximately 18% of the variance.

The auditory- and visual-memory variables were assessed by administering two subtests in each. Auditory memory was assessed by performance on the Memory for Nouns and the Memory for Sentences subtests. Visual memory was assessed by performance on the Memory for Words Forms and the Memory for Pictures subtests. Low correlations were found between the initial measures of each subtest in each variable. Specifically, in School 1 the correlations between Auditory Memory for Sentences and Auditory Memory for Words was .230; the correlation between Visual Memory for Words and Visual Memory for

Pictures was .270. Neither of these correlation coefficients was significant.

Intercorrelations among all variables in School 2 (Phonics). As presented in Table 18, several correlation coefficients reached the r statistic of at least .374 ($p \leq .05$; df=26) necessary to demonstrate significant relationships.

Significant correlation coefficients were computed between word-recognition scores and the initial measures of total visual memory (r=.590), visual discrimination (r=.517), auditory memory for sentences (r=.631), and total auditory memory (r=.545).

Significant correlation coefficients were computed between word-recognition scores and the final measures of visual memory for words (r=.575), visual discrimination (r=.543), visual closure (r=.484), and total visual memory (r=.427). None of the correlation coefficients computed between word-recognition scores and the final auditory variables was significant.

To determine the amount of variance which could be accounted for by knowledge of these relationships, the correlation coefficients were squared. Approximately 40% of the variance on the word-recognition test could be accounted for by variance on the initial measure of auditory memory for sentences.

The following initial variables were related significantly to comprehension scores: total visual memory (r=.597), visual memory for word forms (r=.581), visual discrimination (r=.497), auditory memory for sentences (r=.526), and total auditory memory (r=.458).

TABLE 18
INTERCORRELATIONS AMONG ALL VARIABLES
SCHOOL 2 (PHONICS)

	1	2	3	4	5	6	7	8
INITIAL MEASURES								
1. Vis. Dis.	1.0000							
2. Aud. Dis.	.3777	1.0000						
3. Vis. Mem. Pic.	.3853*	.2585	1.0000					
4. Vis. Mem. Word	.3749*	.4223*	.1154	1.0000				
5. Total Vis. Mem.	.4731*	.4698*	.4624*	.9341***	1.0000			
6. Aud. Mem. Sent.	.4275*	.3741*	.4300*	.3112	.4323*	1.0000		
7. Aud. Mem. Word	.0586	.0781	.4933**	.0690	.2389	.2668	1.0000	
8. Total Aud. Mem.	.3773*	.3403	.5435**	.2845	.4493*	.9315***	.5991***	1.0000
9. Vis. Closure	-.0592	.3010	.1483	.2580	.2836	.5206**	.2611	.5310**
10. Aud. Closure	.1527	.1472	.0281	.1511	.1449	.2344	.0652	.2194
FINAL MEASURES								
11. Vis. Dis.	.4253*	.2556	.4611	.1788	.3253	.4860**	-.0067	.4012*
12. Aud. Dis.	.2644	.3015	.2706	-.0021	.0954	.4951**	.0169	.4177*
13. Vis. Mem. Pic.	.3582	.2891	.3783*	.3386	.4382*	.1946	.1700	.2258
14. Vis. Mem. Word	.5591**	.3426	.4907*	.4190*	.5503**	.3665	.2634	.4039*
15. Total Vis. Mem.	.4354*	.3099	.3629	.4337*	.5176**	.2098	.2916	.2844
16. Aud. Mem. Sent.	.2034	.4035*	.2392	.1884	.2541	.6868***	.4465*	.7391***
17. Aud. Mem. Word	-.2781	-.3554	-.1867	-.3842*	-.4100*	-.1438	.1514	-.0623
18. Total Aud. Mem.	.0957	.2565	.1602	.0456	.0983	.5930***	.4686*	.6695***
19. Vis. Closure	.3849*	.2013	.3205	.5345**	.5923***	.3779*	.1698	.3780*
20. Aud. Closure	.1265	.2247	.1176	.0825	.1159	-.0710	.0239	-.0500
21. Vocabulary	.5170**	.3646	.1750	.5900***	.5896***	.6312***	.0553	.5452**
22. Comprehension	.4970	.3004	.2169	.5815***	.5970***	.5265**	.0551	.4582*

TABLE 18 Continued

	9	10	11	12	13	14	15
9. Vis. Closure	1.0000						
10. Aud. Closure	.1143	1.0000					
FINAL MEASURES							
11. Vis. Dis.	-.1411	.0530	1.0000				
12. Aud. Dis.	.3760*	.1209	.0825	1.0000			
13. Vis. Mem. Pic.	.0903	.0525	.2798	.3129	1.0000		
14. Vis. Mem. Word	-.0062	-.1049	.4937**	.2112	.5876***	1.0000	
15. Total Vis. Mem.	.0545	-.0638	.3538	.0795	.7521***	.8473***	1.0000
16. Aud. Mem. Sent.	.4386*	.1331	.1696	.3675*	.0330	.2104	.1138
17. Aud. Mem. Word	-.2607	-.0774	-.2642	-.0547	-.1049	.1150	.0857
18. Total Aud. Mem.	.3214	.0981	.0688	.3248	-.0048	.2356	.1354
19. Vis. Closure	.5134	.0559	.1667	.0705	.1033	.2336	.2378
20. Aud. Closure	-.0055	.1223	-.0817	.0855	.0268	-.0360	-.0351
21. Vocabulary	.2131	.2157	.5433***	.1759	.1459	.5746**	.4275*
22. Comprehension	.2173	-.0565	.4234*	.1798	.1344	.6256***	.4448*

TABLE 18 Concluded

	16	17	18	19	20	21	22
16. Aud. Mem. Sent.	1.0000						
17. Aud. Mem. Word	.0182	1.0000					
18. Total Aud. Mem.	.9407***	.3564	1.0000				
19. Vis. Closure	.1668	-.4901**	-.0105	1.0000			
20. Aud. Closure	.0235	-.2853	-.0782	-.0316	1.0000		
21. Vocabulary	.3218	-.2501	.2158	.4839**	-.0658	1.0000	
22. Comprehension	.2406	-.2514	.1479	.5102**	-.0530	.8334***	1.0000

* $P \leq .05$

** $P \leq .02$

*** $p \leq .01$

The following final variables were related significantly to comprehension scores: visual memory for words (r=.626), visual closure (r=.511), total visual memory (r=.445), and visual discrimination (r=.423). None of the final auditory measures was related significantly to comprehension scores.

To determine the amount of variance which could be accounted for by knowledge of these relationships, the correlation coefficients were squared. Of the initial measures, approximately 36% of the variance in comprehension could be accounted for by variances in total visual memory scores. Of the final variables, approximately 39% of the variance in comprehension scores could be accounted for by variance in performance on the final measure of visual memory for words.

As in School 1, the variables of auditory memory and visual memory which were obtained by assessment on two subtests had low correlations between the subtests. Specifically, the correlation between auditory memory for nouns and auditory memory for sentences was .267; the correlation between visual memory for pictures and visual memory for word forms was .115. Neither of these coefficients was significant.

2b. Differences between correlations of the auditory and visual measures within schools. It had been hypothesized that in a method which stressed presenting words as whole units, visual abilities probably were related more to reading achievement than were auditory abilities. To test this hypothesis and to determine whether there were significant differences between the correlations of the auditory and visual variables with reading-achievement scores, t tests for correlated samples were computed. These calculations were computed between the correlations of the auditory and visual variables during initial testing with reading-achievement scores, and between the correlations of the auditory and visual variables during the final testing with reading-achievement scores. The raw scores from the auditory and visual measures of discrimination, memory and closure were designated as the auditory and visual variables. The normalized word-recognition and comprehension scores were designated.

As summarized in Table 19, two of the results reached the t statistic of at least 2.04 necessary to demonstrate significant differences between the correlations of the final measures of auditory and visual memory and both word-recognition and comprehension scores. The final measure of visual memory was related more significantly to vocabulary and comprehension than was auditory memory. None of the other computations resulted in demonstrating significant differences between the auditory and visual correlations and reading-achievement scores. Therefore, it did not appear that the visual variables assessed during initial testing were related more significantly to reading achievement than were the auditory measures in a method which presented words as wholes.

It had been hypothesized that in the phonic-linguistic approach, auditory abilities probably were related more to

TABLE 19

t TESTS FOR CORRELATED SAMPLES: DIFFERENCES BETWEEN AUDITORY AND VISUAL CORRELATION COEFFICIENTS

SCHOOL 1 (WHOLE WORD)

N = 34

	r Visual	r Auditory	r Auditory & Visual	t
Initial Testing		Word Recognition		
Discrimination	.470	.389	.198	.429
Memory	.657	.381	.473	1.997
Closure	-.190	.270	-.009	1.909
		Comprehension		
Discrimination	.479	.206	.198	1.379
Memory	.486	.285	.473	1.251
Closure	-.320	.142	-.009	1.932
Final Testing		Word Recognition		
Discrimination	.423	.340	.255	.433
Memory	.490	.063	.592	3.190**
Closure	-.051	.085	-.014	.534
		Comprehension		
Discrimination	.364	.236	.255	.635
Memory	.429	-.033	.592	3.432**
Closure	-.004	.014	-.014	.070

** $p < .01$

reading-achievement scores than were visual abilities. To test this hypothesis and to determine whether there were significant differences between the auditory and visual correlations and reading-achievement scores, _t_ tests for correlated samples were computed. Two calculations were computed: 1) between the correlations of the auditory and visual variables during initial testing and reading-achievement scores; and, 2) between the auditory and visual correlations from the final testing and reading-achievement scores. The raw scores from the auditory and visual measures of discrimination, memory, and closure were the auditory and visual variables.

The results are presented in Table 20. In order for the results to be statistically significant at the .05 level, the resulting _t_ had to be greater than 2.056. The interpretation of the results of the computations indicated that two of the correlations of auditory and visual measures were significantly different. There were significant differences between the auditory and visual correlations of closure after final testing with word-recognition and comprehension scores. It appeared that visual closure was related more significantly to vocabulary and comprehension scores than was auditory closure. None of the other results were interpreted to indicate significant differences between the correlations of the auditory and visual components with reading-achievement scores.

Therefore, it did not appear that the correlations of the initial measures of auditory abilities were related more significantly to reading-achievement scores than were the

TABLE 20

t TESTS FOR CORRELATED SAMPLES: DIFFERENCES BETWEEN AUDITORY AND VISUAL CORRELATION COEFFICIENTS

SCHOOL 2 (PHONICS)

N = 28

	r Visual	*r* Auditory	*r* Visual & Auditory	*t*
Initial Testing		Word Recognition		
Discrimination	.517	.365	.378	.815
Memory	.590	.545	.449	.287
Closure	.213	.215	.114	.007
		Comprehension		
Discrimination	.497	.300	.378	1.027
Memory	.597	.458	.449	.856
Closure	.217	-.056	.114	1.052
Final Testing		Word Recognition		
Discrimination	.543	.176	.082	1.632
Memory	.427	.216	.135	.900
Closure	.484	-.066	-.032	2.191*
		Comprehension		
Discrimination	.423	.180	.082	1.001
Memory	.445	.148	.135	1.266
Closure	.511	-.053	-.032	2.286*

* $p < .05$

initial visual measures in a method which stressed phonics.

2c. Differences in correlations between the two schools. To determine whether there were significant differences in the correlations between some of the initial measures and reading achievement in the two schools, Fisher's r to z transformations were computed. The comparisons were made between visual discrimination, auditory discrimination, total auditory memory, and total visual memory for comprehension and word-recognition scores. These subtests were chosen because the theoretical position of the present study indicated that the two methods of instruction might make differing demands on auditory and visual abilities of the learner. The discrimination and memory variables were chosen because at least one significant correlation coefficient was computed between these variables and the reading-achievement scores. Theoretically, the whole-word approach required visual abilities, whereas a phonics approach required auditory abilities. As presented in Table 21, none of the resulting t statistics was significant. Because none of the correlations between initial variables and word-recognition or comprehension scores differed significantly between the two schools, it did not appear that this study demonstrated that method of instruction or resulting achievement were related more to a student's ability in one mode more than in the other mode.

TABLE 21

COMPARISONS OF CORRELATION COEFFICIENTS BETWEEN SELECTED INITIAL MEASURES AND READING-ACHIEVEMENT SCORES

	Vocabulary			Comprehension		
	School			School		
	1	2		1	2	
	r	r	t	r	r	t
Vis. Discr.	.470	.517	.231	.479	.497	.085
Aud. Discr.	.389	.365	.104	.206	.300	.376
Vis. Mem.	.657	.590	.407	.486	.597	.588
Aud. Mem.	.381	.545	.781	.286	.458	.748

Relationships among initial measures of components of modality preference and reading-achievement scores: partial correlation coefficients. To determine the relationships between the initial measures used to determine modality preference and reading-achievement scores when differences in intelligence were controlled statistically, partial correlation coefficients were computed. These partial correlation coefficients are presented in Table 22. For all measures, the correlation coefficients appeared lower or changed from a positive to a negative correlation when intelligence was controlled statistically. This may indicate the common factors between intelligence-test items and the individual auditory and visual tests employed to measure the components of modality

TABLE 22

PARTIAL CORRELATION COEFFICIENTS BETWEEN INITIAL MEASURES AND READING-ACHIEVEMENT SCORES

(IQ HELD CONSTANT)

	Word Recognition		
	School 1 (WW) (df=32)	School 2 (Phonics) (df=26)	Total Group (df=60)
Vis. Discrim.	.398**	.259	.323*
Aud. Discrim.	.160	.168	.151
Vis. Mem. Pic.	.128	-.048	.034
Vis. Mem. Words	.540***	.494**	.520***
Vis. Mem. Total	.529***	.442*	.490***
Aud. Mem. Sen.	.186	.294	.196
Aud. Mem. Word	-.042	-.175	-.099
Aud. Mem. Total	.133	.130	.115
Visual Closure	-.296	-.015	-.157
Aud. Closure	.081	.030	.074

	Comprehension		
	School 1	School 2	Total Group
Vis. Discrim.	.407**	.283	.363**
Aud. Discrim.	-.028	.118	.032
Vis. Mem. Pic	-.148	.044	-.045
Vis. Mem. Words	.394**	.489**	.451**
Vix. Mem. Total	.318	.472**	.400**
Aud. Mem. Sentences	.060	.203	.088
Aud. Mem. Words	.034	-.131	-.029
Aud. Mem. Total	.064	.083	.059
Vis. Closure	-.411**	.031	-.221
Aud. Closure	-.039	-.275	-.104

**p ≤ .01
***p ≤ .001

preference. For example, in School 2 (Phonics) the Pearson Product Moment Correlation Coefficient between word-recognition scores and visual discrimination was .517; the partial correlation coefficient between word-recognition scores and visual discrimination was .259.

In School 1 (Whole Word), as summarized in Table 22, the visual tests of discrimination and memory (rs=.398, .540 and .529) were related significantly to word-recognition scores when difference in intelligence were held constant. Visual closure was related inversely to word-recognition scores (r= .295), indicating that high scores on the visual-closure test tended to be found with lower word-recognition scores. The auditory-discrimination scores no longer were related significantly to reading-achievement scores (r=.160), when differences in intelligence were controlled by statistical procedures.

Visual discrimination (r=.407) and visual memory for word forms (r=.394) were related significantly to comprehension. Visual closure was related inversely to comprehension scores (r=.411) indicating that high scores on the visual closure test tended to be found with lower reading-achievement scores..

In School 2 (Phonics), as summarized in Table 22 the total visual memory subtest (r=.442 & .472) and the visual memory for word forms (r=.494 & .489) were the only variables which remained significantly related to word recognition and comprehension scores when differences in intelligence of the subjects was partialed out from the correlation coefficients.

For the total group visual memory (rs=.490 & .400) and visual discrimination (rs=.323 & .363) were the best predictors of reading-achievement scores when differences in intelligence of the subjects were controlled statistically.

Question 3: Do the distributions of modality-preference difference scores deviate significantly from a normal distribution? In an attempt to acquire more information about the existence of modality preference within the two samples employed in this study, the distribution of the difference scores used as indicators of modality preference was examined. A difference score was obtained by subtracting the auditory-standard score from the visual-standard score for a given component (discrimination, memory, or closure). Any deviations which were significantly different from zero in the measures of skewness or kurtosis would indicate either a visual or an auditory preference within a sample.

As indicated in Table 23, the means of the difference scores are approximately zero probably indicating equal distributions of auditory and visual scores.

The kurtosis statistic indicates the peakedness of the distribution. The skewness statistic indicates the direction of the longer tail of the distribution. To determine whether either kurtosis or skewness differed significantly from zero indicating deviations from a normal distribution, the difference from zero of each was divided by its standard error (Snedecor, 1937).

TABLE 23

DESCRIPTION OF DISTRIBUTION OF DIFFERENCE SCORES

Difference Score	Discrimination		Memory		Closure	
School	1	2	1	2	1	2
Mean	-.001	-.001	-.012	-.001	.007	-.006
Mode	.832	-.705	-1.716	.133	-1.792	-.358
Minimum	-3.334	-2.472	-2.133	-2.170	-2.390	-2.301
Maximum	2.411	1.979	1.645	1.710	3.500	3.161
Std. Dev.	1.273	1.115	1.026	1.060	1.420	1.340
Kurtosis	.070	-.358	-.888	-.665	-.464	-.069
Skewness	-.477	-.233	-.292	-.428	.522	.306

As summarized in Table 24 none of the resulting t statistics reached at least the 2.00 necessary to indicate significant differences ($p \leq .05$). Therefore, it was concluded that although the descriptive statistics of the distributions indicated deviations from zero in skewness and kurtosis, these deviations were not significant and the distributions of the difference scores probably represented normal distributions in respect to skewness and kurtosis.

TABLE 24

SIGNIFICANCE OF KURTOSIS AND SKEWNESS REPORTED AS t

	School 1 (Whole Word)	School 2 (Phonics)
Discrimination		
Kurtosis	.088	-.417
Skewness	-1.186	.529
Memory		
Kurtosis	-1.128	-.775
Skewness	-.726	-.972
Closure		
Kurtosis	-.589	-.080
Skewness	1.298	-.695

Question 4: Do the children with the lowest reading-readiness scores differ in modality preference from those with the highest reading-readiness scores?

To answer the above question, the Fisher's Exact Probability Test and tables were used (Siegel, 1957). The difference scores in each of the components were summed to indicate a total modality preference score for each subject. This total modality preference score was interpreted to mean that a child had either a visual-modality preference (positive sum) or an auditory-modality preference (negative sum).

Within the cells of the 2 x 2 table appropriate for the Fisher's Exact Probability test, the columns represent the sample number of children with the 10 highest and 10 lowest reading-readiness scores. The rows represent the modality preference of these subjects. Separate analysis was undertaken for each school.

No significant differences in modality preference were found between those with the highest and those with the lowest reading-readiness scores. As presented in Table 25, the cell representing low readiness-visual preference in School 2 (Phonics) failed to have a number equal to one or less than one which was necessary to indicate significant differences between the two groups. In School 1 (Whole Word), the cell representing low readiness-auditory preference failed to have a number equal to zero which would have indicated a significant difference in modality preference. Therefore, it was concluded that both high and low readiness groups could have

TABLE 25

FISHER'S EXACT PROBABILITY TEST: READING READINESS AND MODALITY PREFERENCE

School 1 (Whole Word)

Preference	Readiness High	Readiness Low
Visual	6	6
Auditory	4	4[b]

[b] 0 needed $p < .05$

School 2 (Phonics)

Preference	Readiness High	Readiness Low
Auditory	4	8
Visual	6	2[a]

[a] 1 or less needed $p < .05$

represented random samples from the same population in respect to modality preference and did not appear to differ in modality preference.

Summary

From the interpretation of the analyses, the following results were presented in this chapter:

1. There were no significant relationships between the components used to define modality preference (discrimination, memory, and closure) or total modality preference and word-recognition scores regardless of the method of instruction.

2. There was a significant relationship ($\underline{r}$=.429, $p \leq .05$) between total modality preference and reading-comprehension scores in a classroom which stressed the phonic-linguistic approach. None of the correlations in School 1 or any of the others in School 2 reached significance.
3. When intelligence was controlled through statistical procedures, the relationship between modality preference and comprehension was significant under a phonics approach ($\underline{r}$=.513, $p \leq .01$). There were no significant relationships between modality preference and word-recognition or comprehension scores under a whole-word approach even when differences in intelligence were controlled. The partial correlation coefficient between word-recognition scores and modality preference was not significant under a phonics approach.
4. There were no significant differences between the correlation coefficients obtained in School 1 and School 2 between the components of modality preference and word-recognition or comprehension scores.
5. Children with visual-modality preference scored significantly higher on the word-recognition and comprehension tests than did children with auditory preference in a classroom which stressed phonics ($\underline{t}$=2.12, $p \leq .05$; $\underline{t}$=3.25, $p \leq .01$).
6. There were no significant differences between the reading-achievement scores of those with auditory-modality

preference and those with visual-modality preference in a classroom which stressed presenting words as wholes.

7. In School 1, there were significant differences in rankings on the word-recognition test among the four groups categorized by auditory and visual skills in memory and discrimination. There was a tendency for low rankings in word-recognition scores to be found in the low visual-low auditory groups. There were no significant differences in the rankings on the word-recognition test among the four groups in School 2.
8. There were no significant differences among the four groups categorized according to auditory and visual abilities in respect to rankings on the comprehension test in either school.
9. There were no significant differences in rankings on the word-recognition or comprehension tests among groups defined by amount or degree of preference in either school.
10. In School 1 (Whole Word) significant correlation coefficients were computed between word-recognition scores and initial measures of total visual memory ($\underline{r}$=.657), visual memory for words ($\underline{r}$=.642), visual discrimination ($\underline{r}$=.470), auditory memory for sentences ($\underline{r}$=.451), auditory discrimination ($\underline{r}$=.389), and total auditory memory ($\underline{r}$=.381). Significant correlation coefficients were computed between word-recognition scores and the final measures of total

visual memory (r=.490), visual discrimination (r=.423), and auditory discrimination (r=.340).

11. In School 2 (Phonics) significant correlation coefficients were computed between word-recognition scores and initial measures of total visual memory (r=.590), visual discrimination (r=.517), auditory memory for sentences (r=.631), and total auditory memory (r=.545). Significant correlation coefficients were computed between word-recognition scores and the final measures of visual memory for words (r=.575), visual discrimination (r=.543), visual closure (r=.484), and total visual memory (r=.427).
12. In School 1 (Whole Word), significant correlation coefficients were computed between comprehension scores and initial measures of total visual memory (r=.486), visual memory for word forms (r=.526), and visual discrimination (r=.478). Significant correlation coefficients were computed between comprehension scores and the final measures of total visual memory (r=.429) and visual discrimination (r=.364).
13. In School 2 (Phonics) significant correlation coefficients were computed between comprehension scores and the initial measures of total visual memory (r=.597), visual memory for word forms (r=.581), visual discrimination (r=.497), auditory memory for sentences (r=.526), and total auditory memory (r=.458). Significant correlations were computed between comprehension scores and the final measures of

visual memory for words (r=.626), visual closure (r=.511), total visual memory (r=.445), and visual discrimination (r=.423).

14. In School 1, the only comparisons between the correlation coefficients computed between reading-achievement scores and the auditory and visual measures to reach significance were the comparisons between the auditory and visual measures of memory during final testing and word-recognition score, (t-3.19, $p < .01$), and comprehension (t=3.43, $p < .01$).
15. In School 2, the only comparisons between the correlation coefficients computed between reading-achievement scores and the auditory and visual measures to reach significance were the comparisons between the final measures of auditory and visual closure for both word-recognition scores (t=2.19, $p < .05$) and comprehension scores (t=2.28, $p < .05$).
16. The correlation coefficients computed between the two subtests used to measure auditory memory were low in both schools. In School 1, the correlation coefficient computed between auditory memory for words and auditory memory for sentences was .230. In School 2, the correlation coefficient computed between auditory memory for words and auditory memory for sentences was .267.
17. The correlation coefficients computed between the two subtests used to measure visual memory were low in both

schools. Specifically, in School 1, the correlation coefficient between visual memory for pictures and visual memory for words was .270. In School 2, the correlation coefficient between visual memory for pictures and visual memory for words was .115.

20. There were no significant differences between the correlation coefficients obtained in the two schools between the auditory and visual measures and reading-achievement scores.

21. The correlation coefficients computed between the auditory and visual measures and reading-achievement scores appeared to decrease when intelligence was controlled through statistical procedures. Only the correlation coefficients computed between visual memory for words and total visual memory and word-recognition scores were significant in both schools. The partial correlation coefficient between visual discrimination and word-recognition scores was significant in School 1 (r=.398).

22. The partial correlation coefficients between visual memory for words and comprehension scores were significant in both schools. In addition, in School 1 the partial correlation coefficients between comprehension and visual discrimination (r=.407) and visual closures (r=.411) were significant. In School 2, the partial correlation coefficient between total visual memory was significant (r=.472).

23. The distributions of the difference scores used to determine modality preference did not deviate significantly from normal distributions in measures of kurtosis and skewness.

24. Only 11% of the subjects in School 1 and none of the subjects in School 2 could be classified as having maximum auditory or visual preference as defined in this study.

25. There was no significant difference in the modality preference of those with the highest and those with the lowest reading-readiness scores in either school.

CHAPTER 5

SUMMARY AND DISCUSSION

The purpose of this chapter is to summarize the preceeding chapters. It also presents the conclusions based on the results as well as the discussion of the findings and the suggestions for further research.

Problem

Most children enter school with the ability to learn to read. Yet, some fail at even the initial stages of reading acquisition. One suggested way of lessening this failure and perhaps of preventing later reading disability is to teach the word-recognition skills in a way which is compatible with the auditory or visual strengths of the learner. This construct of auditory or visual strengths has been termed modality preference. The concept of modality preference was based on the premise that some individuals prefer either auditory or visual pathways for processing information. Adapting this concept of modality preference to instructional procedures during early stages of reading acquisition led to the theory that phonics instruction was more compatible with auditory-modality preference than with visual preference. For the corollary position, it appeared the presentation of words as wholes would be more appropriate for those with visual preference than for those with auditory preference. In part, these hypotheses were based on the assumption that success in a method which stresses acquiring symbol-sound associations of individual letters or phonograms (phonic-linguistic approach) may depend more on auditory abilities and less on visual abilities; whereas, success in a method which presents words as wholes depends upon visual abilities while auditory abilities appear to be less important.

Purpose

The purpose of this study was to explore the relationships between modality preference and reading achievement as well as some of the theoretical implications suggested by this relationship. As an intermediate step, this study was to serve as an exploratory investigation of the measurement and determination of modality preference within two groups of first-grade children.

Based on the theoretical construct of modality preference, this study explored the assumption that those with auditory strengths would be more successful in learning to read than those with visual strengths when instruction stressed phonics; whereas, those with visual strengths would be more successful in learning to read than those with auditory strengths when instruction emphasized the whole-word approach.

Samples

Two classrooms of first-grade subjects served as samples. There were 34 subjects in School 1 (Whole Word) and 28 subjects in School 2 (Phonics). Both samples probably represented a population of first-grade students who were of average chronological age, but above average in measures of intelligence and reading readiness when instruction began.

Procedures

Essentially, this research was a case study of subjects within two first-grade classrooms. Each classroom represented a different approach to teaching beginning reading (whole-word approach or phonic-linguistic). The study was conducted from September, 1971 through May, 1972 in two classrooms which were located within different schools.

The purpose of this section is to report the procedures followed. First, the instructional procedures will be presented. Next, the procedures for collection and analyses of data will be presented.

Instructional Procedures

Within each classroom, reading instruction stressed a different method of presenting the word-recognition skills. In the classroom in School 1, instruction stressed learning words as whole units. In the classroom in School 2, instruction emphasized learning new words by forming the symbol-sound associations between or among letters and phonograms and blending these together to form the word. At the initial part of instruction, children in School 1 learned to recognize many words by using them in stories and reading these stories. No direct instruction was provided to associate the symbol of a letter with a sound. In School 2, however, at the initial stages, the sounds that the letters represent were taught. There was little or no emphasis on acquiring recognition of words. Acquiring of words came after this initial period of readiness. Thus, each school was considered to represent different approaches to teaching initial word-recognition skills.

The Bank Street Readers (Macmillan) was chosen as the reading program which represented the whole-word approach. The Palo-Alto Reading Program, Sequential Steps in Reading (Harcourt, Brace, Jovanovich) was chosen as the program to represent the phonic-linguist approach.

Teaching procedures in both schools followed the method presented in the teacher's manual which accompanied each program.

Collection and Analysis of Data

Data Collection. Identifying characteristics of sex and chronological age were collected for each subject. In addition to the instruments used to assess modality preference, tests of auditory and visual acuity, intelligence, reading readiness and reading achievement were administered to each individual within the samples.

All tests were administered by the investigator, a graduate student, or the classroom teacher. Depending on the instrument, tests were administered individually or in small groups. All testing was conducted in the schools which the subjects attended.

Assessment of modality preference. Because the overall purpose of this study was to determine relationships between modality preference and reading achievement, assessing and defining modality preference was a necessary prerequisite. Initially, the modality preference of subjects within the samples was measured by performance on auditory and visual measures of discrimination, memory, and closure. The final measures of modality preference were assessments of performance on the same auditory and visual measures used at the beginning of the study. Whenever possible, an alternate form of the test given earlier was administered. When an alternate form was not available, the same test form was readministered.

Modality preference was defined by an individual's difference score which was computed by subtracting his standard score in an auditory measure from his standard score in the visual measure of the same component. This resulted in preference scores of discrimination, memory, and closure. Total modality preference was computed by summing the scores of each of the components. A positive score was interpreted to indicate visual preference and a negative score was interpreted to indicate auditory preference.

Modality preference determined by difference score

$$z_v - z_a; \text{ where } z = \frac{X - \bar{X}}{s}$$

To determine whether the distribution of the difference scores used to indicate modality preference deviated from normal distributions, measures of central tendency were computed. Statistical descriptions of the distributions involved calculating the mean, mode, range, standard deviation, kurtosis, and skewness for each distribution (discrimination, memory, and closure).

Analysis: Pearson Product Moment Correlation Coefficients were computed to investigate the relationships between modality preference and reading achievement. Partial correlation coefficients were computed to investigate further the relationship between modality preference and reading achievement while controlling the effects of intelligence. Both types of correlations were computed using the difference scores from the initial measures of discrimination, memory and closure. Normalized word-recognition and comprehension scores were used as measures of reaching achievement.

In addition, t tests were computed to investigate difference in reading achievement between those within each classroom who were designated as having either an auditory or a visual preference.

A Kruskal-Wallis One-Way Analysis of Variance by Ranks was the fourth statistical procedure used. Categories were defined based on differential performance on the auditory and visual measures. The categories were designated as high visual-high auditory; high visual-low auditory; low auditory-high visual; and low visual-low auditory. Scores above the group mean were considered high schores; scores below the group mean represented low scores.

Next, a Kruskal-Wallis One-Way Analysis of Variance by Ranks was computed to determine whether significant differences in achievement scores were found among those with various amounts or degrees of preference.

Correlation matrices were constructed to summarize the relationships among the initial and final measures of auditory and visual tests and reading-achievement scores.

Finally, Fisher's Exact Probability Test was employed to determine whether children with lowest reading-readiness scores differed in modality preference from those with the highest readiness scores.

Assumptions

This study was based on the following assumptions:

1. Discrimination, memory, and closure are components of perceptual abilities and modality preference and therefore, could be used as measures of them.

2. The instruments used to measure the auditory and visual abilities of the subjects were valid and reliable.
3. The reading materials used as the treatments were representative of either the phonic-linguistic or whole-word approach.

Limitations

The generalizations which may be made from the results of this study were restricted by the following factors:

1. Only two first-grade classes were employed as samples.
2. The samples were drawn from a population which represented children of middle socio-economic status parents.
3. The teacher's effectiveness with a particular method probably affected the reading achievement of the students within that classroom.
4. Use of different instrumentation or reading programs may have led to different results and conclusions.
5. Defining modality preference in a different way may have led to different results and conclusions.

Findings and Conclusions

The purpose of this section is to present the findings and conclusions related to each question. The discussion will be presented according to the questions posed.

Question 1: Does consideration of modality preference make a significant difference for success in beginning reading? Although this question had been divided into four parts in the earlier chapters, this discussion will encompass all the sub-questions. The related findings will be discussed in two major parts: (a) relationship between modality preference and word-recognition skills and, (b) relationship between modality preference and comprehension-subtest scores.

1a. Relationship between modality preference and word-recognition skills. Three results emerged from the statistical analyses of the data. First, no significant relationships were demonstrated between any of the components of modality preference or total modality preference and word-recognition skills regardless of the method employed in teaching. Second, there were significant differences in achievement between those with visual preference and those with auditory preference when instruction stressed the phonics approach. These differences, however, were not in the expected direction. Those with visual-modality preference scored significantly higher on the word-recognition test than did those with auditory preference. Third, there were no significant differences in word-recognition ability between those with auditory preference and those with visual preference when instruction stressed the whole-word approach.

Further discussion of these results and conclusions will be separated into the results within each method of instruction (phonics and whole word).

Word-recognition skills and phonics instruction. Although the theoretical position of this study suggested that those with auditory preference would be more successful than those with visual preference when receiving instruction stressing phonics, little or no evidence was found to support this position. None of the three statistical procedures employed to investigate this hypothesis resulted in empirical evidence to support it. First, none of the correlations computed between the modality-preference scores and vocabulary scores reached the *r* of .374 necessary to demonstrate significant relationships. Second, none of the statistics calculated with the Kruskal-Wallis One-Way Analysis of Variance technique demonstrated significant differences in achievement between those with high auditory and high or low visual abilities and others within their group. No significant differences in achievement were found which could be attributed to degree or amount of preference. Finally, when comparing achievement of those with auditory preference with those with visual preference under this approach, those with visual preference scored significaltly higher than those with auditory preference (*t*=2.12;

$p < .05$). Therefore, the interpretation of the data did not support the theoretical supposition that those with auditory preference would be more successful than those with visual preference in a reading approach which stresses phonics.

Word-recognition skills under the whole-word approach. There did not appear to be any support for the corollary position that those with visual modality preference would be more successful than those with auditory modality preference when instructed in the whole-word approach. None of the three statistical tests employed to investigate this position resulted in empirical evidence to support this hypothesis. First, none of the correlations computed between modality preference and word-recognition scores reached the correlation coefficient of .337 necessary to demonstrate significant relationships. Second, interpretation of results of the Kruskal-Wallis One-Way Analysis of Variance indicated that only one of the four groups designated by differences in performance on the auditory and visual measures differed from the others. There was a tendency for low rankings on the word-recognition test indicating lower achievement scores to be found in the group defined as having low visual-low auditory discrimination skills. Similar finding was obtained in the memory component. None of the other *H* statistics calculated among these categories in the three components indicated significant differences in achievement. No significant differences in achievement scores were found among those with maximum, middle, minimum or no modality preference. Finally, when comparing scores of those with auditory preference with those with visual preference, no significant differences were found.

Therefore, the interpretation of the data did not support the theoretical supposition that those with visual preference would be more successful in learning to read when instruction stressed the whole-word approach.

1b. Relationship between modality preference and comprehension. Three major findings resulted from the analyses of the data. First, a significant correlation was computed only between total modality preference and comprehension scores in School 2 (Phonics). None of the other correlation coefficients in that school or any of the correlation coefficients in School 1 reached significance. Second, there were significant differences in achievement between those with visual preference and those with auditory preference when instruction stressed the phonics approach. These differences, however, were not in the expected direction. Those with visual preference scored significantly higher on the comprehension test than did those with auditory preference ($\underline{t}=3.25$, $p < .01$). Third, there were no significant differences in comprehension scores between those with auditory preference and those with visual preference when instruction stressed the whole-word approach.

Further reporting of these results and discussion will be separated into two parts: results under phonics instruction and results under the whole word approach.

Comprehension and phonics instruction. Only an equivocal conclusion could be drawn from the interpretation of results because only one correlation reached significance and none of the other results supported the theoretical hypothesis. There was a significant correlation between total modality preference and comprehension ($\underline{r}=.428$, $p < .02$). None of the correlations between the components of modality preference and comprehension reached significance. However, when comparing the mean comprehension score of those with visual preference with those with auditory preference, those with visual preference scored significantly higher ($\underline{t}=3.25$, $p < .01$). When looking for more specific interaction between auditory and visual abilities, none of the statistics calculated with the Kruskal-Wallis One-Way Analysis of Variance technique indicated significant differences in achievement among those with high auditory abilities and others within the class. There were no significant differences in achievement attributable to differences in amount or degree of preference. Therefore, little empirical evidence could be demonstrated to support the position that those within this sample with auditory preference would be more successful in learning to read than those with a visual preference when instruction stressed phonics.

Comprehension and whole-word instruction. There did not appear to be any evidence from this study that those with visual preference would be more successful in learning to read than those with auditory preference when instruction stressed presenting words as wholes. None of the correlations between the components of modality preference or total modality preference reached the r of .337 necessary to demonstrate significance nor did any of the components account for more than 10% of the variance in comprehension scores. When investigating more specific interaction between auditory and visual abilities and comprehension scores, none of the results of the Kruskal-Wallis One-Way Analysis of Variance indicated significant differences in achievement among those with high visual abilities and others within their classroom. There were no significant differences in the mean comprehension scores of those with visual preference and those with auditory preference in this school. Finally, no differences in achievement could be attributed to differences in amount or degree of preference. Therefore, the data for this sample did not support the hypothesized position that those with visual preference would become better readers than those with auditory preference when instruction stressed presenting words as wholes.

Discussion of the results. The failure of this study to find significant relationships between modality preference and word-recognition ability as measured by the vocabulary-subtest scores may be due to three possibilities. First, the sample size and its characteristics masked the relationship. Second, acquiring of word-recognition skills is facilitated by use of both auditory and visual abilities. Third, modality preference, as it is currently concerned in the literature, may not be an important characteristic for learning to read.

Detecting modality preference or weakness within an individual or a group may require larger samples than the one employed in this study. Robinson (1972) suggested that a sample size of 1000 may be necessary in order to draw enough subjects with modality preference to get significant relationships. The sample employed in this study was much smaller (N=62) and that may have precluded having a large enough sample to achieve significance with the statistical procedures used. Less than 11% of the subjects in School 1 and none of the subjects in School 2 demonstrated either an auditory or visual preference in the three components measured.

The sample employed for this study probably represented children with better than average intelligence. Although modality preference has been demonstrated to be independent of intelligence (*r*=-.172 in School 1 and *r*=-.023 in School 2), this sample may have been drawn from a population with better than average auditory and visual abilities. Robinson (1972) demonstrated within her sample that the subjects who scored lower in both the auditory and visual tests also scored lower on the measure of intelligence. Therefore, because these samples probably represented populations with better than average intelligence, actually those children who scored the lowest on the auditory and visual measures may be closer to the mean when compared with a larger sample which would be more representative of a normal or average population. Thus, because this sample was small and may have been atypical, it failed to provide enough subjects with either an auditory or a visual preference to achieve significance with the statistical procedures employed.

From the interpretation of the data, it appears that both auditory and visual skills may be more important to success at the initial stages of reading than modality preference. Both auditory and visual skills may be prerequisite to acquiring sight words and symbol-sound associations. Because of this finding, it now appears open to question whether the whole-word and phonic approaches do make different demands on the learner. Interpretation of the results of the correlation coefficients suggest that memory was the perceptual test which related the most to reading achievement in both schools ($\underline{r}$=.657 in School 1 and $\underline{r}$=.590 in School 2).

Another possible explanation for not finding significant relationships between modality preference and word-recognition skills is that for middle-income populations such procedures may not be necessary to facilitate learning because these children learn through both auditory and visual channels. Neither Bateman (1968) nor Robinson (1972) were able to demonstrate significant differences in achievement attributable to teaching word-recognition skills in a way which was compatible with the modality preference of the individuals within their middle-income populations.

Another indication that teaching to modality preference may not be necessary was the limited number of children who demonstrate preference. Although she had anticipated that 25% of her sample would have either auditory or visual preference, Robinson (1972) found that only 11% could be defined that way. In this study, the total population was even smaller and there did not appear to be any differences in achievement due to amount or degree of preference.

By the time they enter first grade, most children do not demonstrate strong modality preference or appear to acquire information through both auditory or visual modalities. Therefore, teaching to modality preference may be less important than developing other skills necessary to acquiring reading.

Because there was one significant correlation coefficient, the relationship between modality preference and comprehension appeared to be higher than the relationship between modality preference and word recognition. This result was surprising because acquisition of word-recognition skills theoretically would appear to rely more upon teaching to the preferred modality than would comprehension skills. Comprehension implies the use of cognitive skills and acquiring specific types of comprehension skills as well as word-recognition ability. Therefore, it was anticipated that teaching to modality preference would be more important for a perceptual task (word-recognition) than a cognitive one.

One explanation of the significant correlation between comprehension and modality preference in School 2 is that a Type I or Alpha error has been made. That is, results were stated to be significant at a confidence level, when in fact the results were due to chance. This appears to be a very probable explanation for this significant correlation because none of the other correlations between the measures used to define modality preference and reading vocabulary or comprehension was significant in either school. Only a repetition of the study with larger sample sizes would shed more light on the relationship.

All the explanations in the word-recognition section may be applied to the failure of this study to demonstrate more than one significant relationship between modality preference and comprehension.

Question 2: Do the whole-word and phonic-linguistic beginning reading approaches demand differing perceptual abilities on the part of the learner?

The results of the statistical analyses of the data did not support the contention that auditory abilities were related more to success than visual abilities when instruction stressed phonics. Nor did the interpretation of the results support the contention that visual abilities were related more to reading-achievement scores than were auditory abilities when instruction stressed the whole-word approach. First, both auditory and visual measures correlated significantly with reading-achievement scores in both approaches. Second, there were no significant differences between the initial auditory and visual correlations and reading-achievement scores within each school. Finally, there were no significant differences between the two schools on the auditory and visual correlations computed between the initial measures of discrimination and memory and reading-achievement scores.

Reading Achievement

Word Recognition. In School 1 (Whole Word) the following initial variables were related significantly to word-recognition scores: total visual memory (r=.657); visual memory for words (r=.642); visual discrimination (r=.470); and, total auditory memory (r=.381). Thus, approximately 40% of the variance on the vocabulary scores could be accounted for by variance in the visual memory for words subtest.

In School 2 (Phonics), the following initial variables were related significantly to word-recognition scores: visual memory for words (r=.590); visual memory total (r=.590); visual discrimination (r=.517); auditory memory for sentences (r=.631); and, total auditory memory (r=.545). Therefore, variance on the auditory memory for sentences accounted for approximately 40% of the variance on the vocabulary subtest.

Comprehension. In School 1 (Whole Word) the following initial measures were related significantly to comprehension scores: visual memory for words (r=.526); visual memory total (r=.486); and visual discrimination (r=.479). None of the auditory tests were related significantly to comprehension scores. Thus, approximately 28% of the variance of the comprehension scores could be accounted for by variance on the visual memory for word subtest.

In School 2 (Phonics), the following initial measures were related significantly to comprehension scores: total visual memory (r=.597), visual memory for words (r=.581), visual discrimination (r=.497), auditory memory for sentences (r=.526), and total auditory memory (r=.458). Thus, variance on the total visual memory test appeared to account for approximately 36% of the variance of comprehension scores.

In both schools, word-recognition scores had the highest correlations with comprehension scores (r=.822 and r=.833). Therefore, approximately 69% of the variance in comprehension scores could be accounted for by variances in performance on the measure of word-recognition skills.

Low correlations were found between the two subtests used to measure visual memory although both were considered to measure the same ability. The correlation coefficients between visual memory for words and visual memory for pictures were .271 in School 1 and .115 in School 2, indicating the relative independence of the measures. Two reasons are offered for these low correlations: (1) there may be separate storage places for words and pictures in short-term memory, or (2) one of the tasks may be more familiar to young children and therefore easier to recall. Unfortunately, there is not enough evidence about short-term memory storage to evaluate the possibility of two types of storage. The more likely explanation for differences and the one supported by research (Corsini, 1969) is that memory for pictures may be an easier task for young children than is memory for word forms which could be considered unfamiliar stimuli.

Low correlations were found also between the two subtests used to assess auditory memory. The correlation coefficients calculated between Auditory Memory for Words and Auditory Memory for Sentences were .230 in School 1 and .267 in School 2. It appeared that the two tasks which appeared to assess the same ability, auditory memory, were not related significantly. Again, Auditory Memory for Words test may measure the limits of short-term memory. Sentences may be easier to recall because meaningfulness gives structure to the encoding and recall of the items.

Discussion: From the interpretation of the data, it appears that both auditory and visual skills are related to success at the initial stages of reading acquisition regardless of the method of instruction employed. Although one study is not the basis for final conclusions, it does open to review not only the validity of the construct of modality preference but also the necessity that more research is needed to explore the underlying supposition concerning necessary prerequisite skills for reading success.

These results suggest that memory tasks are important correlates with word-recognition skills. Further research may support a position that the initial stage of reading may involve learning to learn or remember word forms in the most efficient manner no matter which method of instruction is employed. If such a position is viable, it may support Biemiller's position (1970) that beginning readers develop reading skills in phases. One of the first phases is making use of graphic information. It may be at this first stage that memory plays an important part in learning the word forms.

Question 3: Does the distribution of modality-preference difference scores deviate significantly from a normal distribution?

One of the failings of research investigating modality preference has been the absence of a clear definition. Each study defined it in a different way. Therefore, a facilitating procedure in this study was to try to determine modality preference and describe the distribution. For the purposes of this study, modality preference was defined as the difference score which was obtained by subtracting the standard score in an auditory measure from the standard score in the visual measure of the same component. A positive score was interpreted to indicate visual preference and a negative score was interpreted to indicate auditory preference. This procedure was allowable providing the two distributions were similar (Ferguson, 1971).

The interpretation of the Kolmogorov-Smirnov Two-Sample Tests results indicated that both the auditory and visual distributions within each component could have been drawn from populations with the same distribution. However, the conclusion was drawn from the interpretation of the Wald-Wolfowitz Runs Test on the same distributions that the auditory and visual distributions in each component did differ in some way. There does not appear to be any explanation for these differing results.

The distributions of the difference scores in each of the components formed a normal distribution. There were no significant deviations in kurtosis or skewness. Therefore, it appeared for the samples used in this study, the distributions of the modality-preference difference scores were normal. However, because difference scores were obtained by subtraction of standard scores, the distributions may reflect the normalized-score distribution rather than a distribution of modality preference within a population.

Few subjects in either school had maximum modality preference as it was defined in this study. In School 1, two subjects were classified as exhibiting maximum visual preference and only one subject as exhibiting maximum visual preference. This was approximately 11% of that sample. In School 2, none of the subjects could be classified as having either maximum auditory or visual preference.

Discussion: The distribution of difference scores followed a normal distribution. Although there were no differences in central tendency between the auditory and visual measures within the same component, the two distributions within each component did differ in some way.

In School 1, 11% of the subjects were classified as having maximum modality preference. None of the subjects in School 2 met the conditions to be classified as having maximum modality preference. The proportion of subjects which could be classified as having maximum preference increasdd when the requirement was removed that there must be at least one-half standard-score difference between the auditory and visual measure to demonstrate preference within a component. In School 1, six subjects obtained three positive difference scores indicating visual preference and five subjects had three difference scores indicating auditory preference. In School 2, four subjects were classified as having auditory preference and one subject demonstrated visual preference in all three components. Approximately 25% of the subjects in both samples could be classified as having either an auditory or a visual preference when modality preference was defined only by obtaining three difference scores in the same direction but not including magnitude of that direction.

Although she had anticipated finding as much as 25% of her sample demonstrating modality preference, Robinson (1972) could classify only 11% of them that way. A similar proportion of the subjects in School 1 were identified as having maximum modality preference. None of the subjects in School 2 could be classified as having modality preference. However, when the conditions were changed for defining modality preference, approximately 25% of the subjects in the combined samples could be classified as demonstrating maximum modality preference. This was closer to Robinson's expectation.

For future research to be conclusive about the existence of modality preference, an adequate definition must be evolved. Each study in the past has defined modality preference in a different way. In order to assess modality preference within a population, it must be defined in operational terms. Until studies can be replicated which define modality preference in the same way, its frequency, occurrence, and nature within a population will remain speculative. Assessment of modality preference must be extended to other than middle socio-economic status populations. Until further defining and assessment is undertaken, little practical application can be gained from the generalizations of this and other studies in this area.

Question 4: Do children with the lowest reading-readiness scores differ in modality preference from those with the highest reading readiness scores?

The results of the Fisher Exact Probability Test were interpreted to indicate that there was no significant difference in modality preference between those with the ten highest and those with the ten lowest reading-readiness scores. This conclusion was true for both School 1 (Whole Word) and School 2 (Phonics). The two groups within each school could have represented random samples from the same population with respect to modality preference. Furthermore, none of the components of modality preference was related significantly to reading-readiness in either school. It appeared that reading-readiness scores were independent of modality preference.

In each of the schools, there was a high correlation between total visual memory and readiness (r=.612 in School 1 and r=.501 in School 2). Approximately 37% of the variance in readiness scores could be accounted for by variance on the total visual-memory test.

Discussion: It did not appear that modality preference was one of the characteristics which differed between those with high and those with low reading-readiness scores. Based on Wepman's (1968) statement that those with auditory preference develop language earlier than those with visual preference, it may have been expected that those with higher reading-readiness scores would exhibit auditory preference because reading is a language activity. However, the reading-readiness test has few measures of language usage; instead, several of the tests appear to measure visual and visual-motor skills. This may explain in part, the high correlations between visual-memory tests and reading-readiness scores.

IMPLICATIONS FOR RESEARCH AND PRACTICE

From the results and conclusions of this study, implications may be drawn in three areas: (1) modality preference; (2) teaching beginning reading; and, (3) research practices.

Modality Preference

The interpretation of two of the results of this study opens to question the current definition of modality preference. The theoretical position employed in this study defined modality preference as an individual's preference of one modality more than the other for acquiring information. Such a broad definition failed to take into account performance during varied tasks and degree of that preference. During the investigation of this study, modality preference did not appear to be a unimodal phenomenon for all tasks. Second, the placement of subjects into categories based on modality preference differed when magnitude of preference was included in the definition.

If modality preference is a valid construct to describe the processes of perceptual learning, one might expect that children would prefer the same modality, auditory or visual, for all perceptual tasks. However, for most of the middle-class subjects employed in this study, modality preference was not a unimodal phenomena. For 75% of the subjects in the combined samples, preference to do well in an auditory or visual task appeared to be related to the task. For example, a subject may have demonstrated auditory preference on the discrimination component but visual preference on the closure component.

Second, categorization of the subjects employed in this study was affected by the definition of modality preference. Approximately 25% of the subjects in the combined samples could be categorized as demonstrating maximum modality preference when it was defined only by the direction of the three difference scores. That is, scores of 25% of the sample could be placed into the maximum modality-preference category when the only requirement was that the three difference scores were all negative or all positive. When the requirement was set that in addition to direction, magnitude was important, few subjects in the combined sample could be categorized as demonstrating maximum auditory or visual preference. That is, when difference scores in all components were required to be at least .5 in the same direction, scores of only 11% of the subjects in School 1 and none of the scores of the subject in School 2 could be placed into the maximum-modality preference category.

Because so few children demonstrated preference as it was defined in Robinson's study and in this study, it may cease to be a dominant characteristic of children at this stage in their development. Wepman (1960) suggested that teaching to modality preference was important to develop a perceptual basis for learning and may be related to language acquisition. It may be that children do prefer one modality more than the other at the early stages of development. However, by the time they enter school they have had many experiences and time which would allow for equivalent development of the weaker modality. Perhaps, by the time children enter school, cognitive skills become more important for learning than the modality through which they acquire information.

Teaching Beginning Reading

If the first phase of reading acquisition is acquiring word-recognition skills to make use of the graphic information (Biemiller, 1970), the job of the teacher is to facilitate the learning of these skills. One theoretical position stated that teaching would be more effective by presenting the word-recognition skills in a manner which was compatible with the modality preference of the learner. It was hypothesized that phonics instruction would be appropriate for those with auditory preference but that whole-word instruction would be appropriate for those with visual preference. It was suggested that failure at the early stages of reading acquisition would be lessened by matching instructional procedures with characteristics of the learner.

Based on the results and conclusions of this study and others (Bateman, 1968; Harris, 1965; Robinson, 1972), it does not appear that preventing reading failure may be accomplished as easily as teaching word-recognition skills in a way which is compatible with the learner's modality preference. At best, the theory of teaching to the modality preference of the learner suggests that more is known about the teaching process than the learning process. It suggests that good teachers try to follow procedures which appear to facilitate learning to read and which allow for individual differences. What the theory and research findings do not account for is that some children succeed while others receiving the same instruction and using the same materials fail. With little research to indicate the best teaching procedures, teachers need to continue to present words in a variety of ways to help children build associations, to remember word forms, and perhaps even to attract the attention of those with poor attending behavior.

Finally, the interpretation of the results of this study suggested that not only was there little support for the position that teaching word-recognition skills in a manner which was compatible with the learner's modality preference would improve learning but also that there was little evidence that the underlying premise was true. That is, none of the results supported the premise that auditory abilities were related more to the phonic-linguistic approach than to the whole-word approach or for the corollary position that visual abilities were related more to the whole-word approach than to the phonic-linguistic approach. Further research is needed to clarify the relationship between auditory and visual abilities and the demands made on the learner by the approach being employed.

Because generalizations made from research may not be applied to populations differing in characteristics from the same population, the implications from this study may not be appropriate for particular individuals receiving remedial instruction or for children from other than middle-income populations.

Research Practices

Few would disagree with Cullinan's conclusion (1969) that both auditory and visual abilities are related to reading-achievement scores. What needs to be done is to reexamine and clarify these relationships. The relationships between auditory and visual skills and reading-achievement scores appear to vary depending whether they were measured at the beginning or end of first grade and whether intelligence was controlled.

Different correlation coefficients were obtained in this study between reading-achievement scores and the same variable when it was measured at the beginning or ending of first grade. For example, in School 2 the initial measures of visual closure (rs=.213 & .217) were not related significantly to reading vocabulary nor comprehension scores but the final measure of visual closure was related significantly at the beginning of first grade were not significant at the end of first grade. These findings could be interpreted to explain that the various research studies demonstrated different correlations between auditory and/or visual abilities and reading-achievement scores because of differences in the time the tests were administered.

All the correlation coefficients obtained between the initial testing variables and reading-achievement scores appeared lower when intelligence was controlled. This implies the high loading of similar tasks on both the intelligence tests and the measures of auditory and visual abilities. In the practical sense, children come to school with differing intelligence scores and therefore differences in intelligence scores may account for some of the variance on reading-achievement tests. However, when controlling for differences in intelligence, only the correlation coefficients computed between visual memory for words and total visual memory were related significantly to both vocabulary and comprehension scores in both schools. Therefore, the various auditory and visual tests administered may reflect factors of intelligence rather than "pure" perceptual abilities. It appeared that in addition to intelligence, variances in memory-test scores may account for variances in reading-achievement scores.

Thus, it appears that researchers will need to define more carefully the type of child they are evaluating.

Suggestions for Further Research

Because this study demonstrated some significant relationships but was unable to demonstrate the relationship between modality preference and reading achievement, further research appears to be warranted. Enumerated below are some suggestions for further research which appears related to the findings of this study.

(1) This study should be repeated using a sample which represents a different population. Modality preference may have important instructional implications for those whose IQ scores are lower than the sample employed in this study or who represent different socio-economic populations.

Because larger numbers may be necessary to detect modality preference, testing time will need to be shortened. Because the measures of visual discrimination, visual memory for words, and auditory memory for sentences were shown to be related significantly to reading achievement, they should be repeated. Because a measure in the auditory mode is needed to correlate with the visual discrimination measure, an auditory discrimination test should be administered also.

(2) As an alternate procedure to testing for modality preference, demonstration or mini-lessions might be given at the end of kindergarten or the beginning of first grade. The purpose of these lessons would be to detect the method of instruction which makes it easier for the child to learn words. By recording the number of words retained, the teacher may be able to draw inferences about the method of instruction appropriate for each pupil. Both short-term and long-term retention could be evaluated. The procedure is similar to the one recommended by Mills (1956).

(3) To clarify further the relationship between auditory and visual abilities and reading achievement, exploratory procedures

should include both testing and teaching in these areas. This allows for the study of possible effect of teaching and/or training auditory and visual skills on reading-achievement scores.

(4) Although not measured in this study, classroom observation indicated that children appeared to exhibit differences in attending behavior. There is a need for research to explore these differences in attention as a possible factor related to differences in achievement during the early stages of reading acquisition.

(5) Further research is needed to clarify the perceptual demands made on the learner by the different approaches to beginning reading.

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APPENDIX A

DIFFERENCE SCORES OF SUBJECTS

School 1

Subject	Discrimination	Memory	Closure
01	1.6397	1.4665	-.3048
02	.0608	.1010	.0797
03	.5437	-.3091	-1.7451
04	-1.3878	-1.0447	2.5911
05	-1.9359	1.5849	1.3215
06	.7851	1.0692	-.7045
07	- 4873	-1.1462	1.4360
08	-2.2884	.5407	-1.6594
09	-.2676	-1.4843	-1.1458
10	-.9919	-.9263	-.4465
11	1.5963	.7478	2.2211
12	-.2242	.5703	-1.5304
13	.6305	-1.3660	.0381
14	.3891	-.0892	3.5052
15	-.0044	.7014	.0245
16	-1.6944	.7902	-.6332
17	-.0044	-1.7042	-.8174
18	.8285	.8493	.5091
19	1.1351	-.5585	-1.3021
20	.2587	.2322	1.2782
21	.1042	-1.7042	-2.4012

DIFFERENCE SCORES IN SUBJECTS--Continued

Subject	Discrimination	Memory	Closure
22	-.7070	-.4570	1.4648
23	.8285	.0714	-1.5881
24	2.4074	.9676	-.3472
25	-1.3202	1.1284	1.6355
26	.3022	1.6568	-.7461
27	1.6397	-.0301	-.8887
28	-.6418	-.2795	1.3503
29	1.9246	.9972	-.7173
30	.0390	-2.1311	1.6499
31	-1.2550	-.5754	-.9312
32	.6088	.9381	.0806
33	.7851	.0123	-1.8020
34	-3.2975	-.6177	.5228

DIFFERENCE SCORES IN SUBJECTS

School 2

Subject	Discrimination	Memory	Closure
01	-.7040	.4167	.6347
02	.5293	-.0535	-.3601
03	.6383	-1.1004	-1.8916
04	.0609	.9136	3.1587
05	-2.4727	.5498	.7120
06	1.9806	-2.0142	-.0581
07	-1.4841	-1.0560	1.8111
08	-.5166	-.6480	.1384
09	-2.0979	-1.4198	.6749
10	-.2566	-.2309	-.9898
11	1.5905	1.1797	.4084
12	.3209	.5942	-2.3752
13	1.8506	-2.1472	-.5038
14	-1.2604	.1327	-.9748
15	-.8130	.4965	.2947
16	.3420	.4965	-1.7606
17	.3209	.9136	-.4510
18	.8256	1.4192	.0982
19	-.9641	-.2753	1.0425
20	.6383	1.1442	-2.1259
21	-.8340	.2748	.1257

DIFFERENCE SCORES IN SUBJECTS--Continued

Subject	Discrimination	Memory	Closure
22	-.1628	.1327	1.1690
23	1.4394	1.3749	-.3601
24	.0971	-.8254	-.4785
25	.9920	-.4528	2.6118
26	.7683	.1327	-1.7606
27	-.1266	-1.6415	1.4734
28	-.7040	1.6943	-.2672

MEMORY FOR PICTURES [a]

Directions: Examiner: "I am going to show you some pictures, one picture at a time. When I have finished showing you all of the pictures, tell me the names of as many of the things as you can remember. You do not have to tell the names in order. Do you understand what to do?"

The examiner presents the pictures at the rate of one per second with a pause of one second between stimuli.

Items:

Bear
Key
Girl or Doll
Bus
Sock
Door
Car
Desk

Scoring: One point was awarded for each correct response or an acceptable synonym.

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[a] Adapted from the Katz and Deutsch study (1963 a).

APPENDIX C

MEMORY FOR NOUNS SUBTEST[a]

Directions: The examiner says: "I am going to say some words. When I have finished saying all of the words, tell me as many of the words as you can remember. You do not have to say them in the same order as I did. Do you understand what you are to do?"

The examiner says the following words allowing a pause of one second between the stimuli.

Items:

Ball
Fish
Hat
Clock
Dog
Dress
Shoe
Clown

Scoring. One point was awarded for each correct response or an acceptable synonym.

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[a] Taken from the Katz and Deutsch study (1963 a).

APPENDIX D

NUMBER OF SUBJECTS CLASSIFIED ACCORDING TO AMOUNT OF MODALITY PREFERENCE

	VISUAL PREFERENCE			NO	AUDITORY PREFERENCE		
	Maximum	Middle	Minimum		Minimum	Middle	Maximum
	N	N	N		N	N	N
1[a]	02	07	03	12	00	09	01
2[b]	00	07	03	07	05	06	00

[a] = Subjects in School 1 N=34

[b] = Subjects in School 2 N=28

APPENDIX E

SUBJECTS CLASSIFIED ACCORDING TO DIFFERENTIAL PERFORMANCE ON THE AUDITORY AND VISUAL TESTS

	HV-HA	LV-HA	HV-LA	LV-LA
	N	N	N	N
		School 1 (N=34)		
Discrimination	15	04	06	09
Memory	14	05	04	11
Closure	08	06	09	11
		School 2 (N=28)		
Discrimination	11	03	06	08
Memory	07	05	06	10
Closure	10	09	05	04

HV-HA	High Visual - High Auditory Scores
LV-HA	Low Visual - High Auditory Scores
HV-LA	High Visual - Low Auditory Scores
LV-LA	Low Visual - Low Auditory Scores

APPENDIX F

IDENTIFYING CHARACTERISTICS OF SUBJECTS

School 1

Subject	Sex	CA[a]	IQ	Reading Readiness Score
1	F	760	114	62
2	M	810	127	73
3	F	710	108	67
4	F	790	114	71
5	M	700	113	71
6	F	780	127	84
7	F	710	125	64
8	M	750	116	50
9	M	730	124	68
10	F	750	116	61
11	F	780	088	53
12	F	810	122	72
13	M	780	119	59
14	M	840	102	52
15	M	810	136	91
16	M	790	130	67
17	F	720	123	62
18	M	800	121	66
19	M	700	119	55
20	M	720	134	80
21	F	770	108	57
22	M	740	114	51

IDENTIFYING CHARACTERISTCS OF SUBJECTS--Continued

School 1

Subject	Sex	CA[a]	IQ	Reading Readiness Score
23	F	740	104	74
24	M	810	109	67
25	F	760	113	70
26	M	760	121	75
27	F	760	114	57
28	F	750	104	43
29	F	810	110	62
30	M	810	113	75
31	F	790	118	70
32	F	740	112	65
33	M	830	107	55
34	M	710	101	47

[a] CA is reported in months and was computed as of October 1, 1971.

IDENTIFYING CHARACTERISTICS OF SUBJECTS

School 2

Subject	Sex	CA^a	IQ	Reading Readiness Score
1	F	770	133	79
2	F	710	103	60
3	F	780	122	85
4	F	720	113	74
5	M	790	109	65
6	M	720	128	65
7	M	770	109	62
8	F	760	115	71
9	F	710	100	58
10	M	690	130	74
11	M	870	067	64
12	F	750	108	71
13	M	770	141	85
14	M	780	096	58
15	M	820	081	55
16	F	700	102	49
17	F	790	112	80
18	M	740	124	71
19	M	790	121	68
20	M	820	114	67
21	M	780	129	82
22	M	730	110	70

IDENTIFYING CHARACTERISTICS OF SUBJECTS--Continued

School 2

Subject	Sex	CA[a]	IQ	Reading Readiness Score
23	F	810	123	85
24	F	710	112	71
25	F	810	122	89
26	M	780	111	74
27	F	740	134	80
28	M	750	124	71

[a] CA reported in months and computed as of October 1, 1971.

WORD RECOGNITION

SCHOOL 1

Subject	Grade-Level Score	Standard Score*	Ranking
1	1.6	43	19.0
2	1.9	48	25.0
3	2.0	49	27.0
4	1.6	41	13.5
5	1.4	35	4.0
6	3.5	67	33.5
7	1.6	42	17.0
8	1.6	41	13.5
9	2.2	51	28.5
10	1.5	39	9.0
11	1.4	36	6.0
12	3.0	59	32.0
13	1.0	29	1.0
14	1.3	33	2.0
15	3.5	67	33.5
16	1.0	29	1.0
17	1.8	47	22.0
18	1.8	47	22.0
19	1.8	47	22.0
20	2.5	53	30.0
21	1.4	36	6.0
22	1.6	42	17.0
23	1.9	48	25.0
24	1.4	36	6.0
25	1.7	46	20.0
26	2.6	54	31.0
27	1.6	41	13.5
28	1.4	37	8.0
29	1.6	42	17.0
30	1.5	40	10.5
31	2.2	51	28.5
32	1.5	40	10.5
33	1.6	41	13.5
34	1.3	34	3.0

* Denotes score from norms reported in Examiner's Manual of test.

COMPREHENSION

SCHOOL 1

Subject	Grade-Level Score	Standard Score*	Ranking
1	1.4	35	6.5
2	2.1	53	29.0
3	2.0	52	27.5
4	1.3	34	3.0
5	1.4	35	6.5
6	3.4	62	32.0
7	1.6	45	17.0
8	1.4	37	10.5
9	1.5	40	13.0
10	1.4	37	10.5
11	1.4	35	6.5
12	3.7	67	33.5
13	1.4	35	6.5
14	1.7	47	21.0
15	3.7	67	33.5
16	1.6	49	25.0
17	1.7	47	21.0
18	1.8	49	25.0
19	1.6	46	18.5
20	2.0	52	27.5
21	1.7	47	21.0
22	1.5	42	15.0
23	2.5	57	30.5
24	1.4	35	6.5
25	1.5	42	15.0
26	2.7	57	30.5
27	1.6	46	18.5
28	1.2	29	1.5
29	1.8	49	25.0
30	1.5	42	15.0
31	1.7	48	23.0
32	1.4	35	6.5
33	1.5	38	12.0
34	1.2	29	1.5

*Denotes score from norms of test population and found in Examiner's manual of test.

WORD RECOGNITION TEST

SCHOOL 2

Subject	Grade-Level Score	Standard Score*	Ranking
1	3.0	59	25.5
2	1.0	28	2.5
3	1.5	38	6.5
4	1.0	28	2.5
5	1.5	38	6.5
6	1.6	41	13.0
7	1.5	39	8.5
8	2.1	50	20.5
9	1.7	44	16.0
10	2.8	58	23.5
11	1.5	40	11.0
12	1.7	45	17.0
13	2.5	53	22.0
14	1.0	28	2.5
15	1.3	34	5.0
16	1.0	28	2.5
17	2.1	50	20.5
18	2.8	58	23.5
19	1.6	42	14.0
20	2.0	49	19.0
21	1.6	43	15.0
22	1.5	40	11.0
23	3.0	59	25.5
24	1.5	39	8.5
25	1.8	47	18.0
26	1.5	40	11.0
27	3.3	65	28.0
28	3.2	63	27.0

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* Denotes score from norms of test population and found in examiner's manual of test.

COMPREHENSION

SCHOOL 2

Subject	Grade-Level Score	Standard Score*	Ranking
1	3.4	62	27.0
2	1.4	35	2.5
3	1.4	37	5.0
4	1.9	50	22.0
5	1.4	37	5.0
6	1.5	42	9.5
7	1.5	42	9.5
8	1.6	46	16.5
9	1.8	49	20.0
10	2.8	58	25.0
11	1.6	43	11.5
12	1.8	49	20.0
13	1.6	44	13.5
14	1.6	44	13.5
15	1.3	34	1.0
16	1.4	35	2.5
17	1.6	46	16.5
18	2.2	54	23.0
19	1.6	46	16.5
20	1.6	43	11.5
21	1.4	37	5.0
22	1.5	40	8.0
23	3.6	64	20.0
24	1.5	38	7.0
25	1.8	49	20.0
26	1.6	46	16.5
27	3.0	60	26.0
28	2.5	57	24.0

* Denotes score from norms of test population and found in examiner's manual of test.